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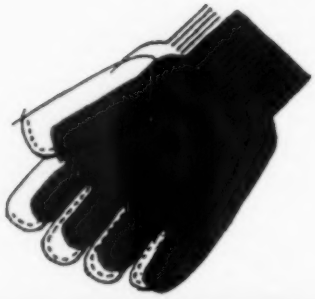
JOURNAL

VOLUME 10, NUMBER 1 • JANUARY, 1954

JAN 19 1954

Emmett O'Grady, banquet speaker at the Tenth SPE Technical Conference in Toronto, January 28, 1954. (See story on page 18).



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JOURNAL

Vol. 10 January, 1954 No. 1

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The Society of Plastics Engineers Journal is not responsible for the views expressed by individual contributors. Copy for each issue should be received at The Security Bank Bldg., Athens, Ohio before the first of the preceding month.

Across the Editor's Desk

• The "Symposium on Plastics Testing — Present and Future" is a 76 page book with heavy paper cover published by A.S.T.M. It contains papers presented at their 55th annual meeting and covers; Measurement and Significance of the Mechanical Strength Properties of Plastics; Effect of Temperature on Some Physical Properties; Measurement of Color, Gloss and Haze; Effects of Molding Conditions Upon the Permanence of Plastics; Residual Stresses in Phenolics. Price is two dollars. A.S.T.M. is at 1916 Race St., Philadelphia.

• A couple of months ago we published an article on the company publications in the plastics business. One we missed is the excellent "The Plastics Sphere" published by Canadian Industries Ltd., Polythene Div., Box 10, Montreal, Quebec. This beautifully done magazine is published quarterly and runs about 16 pages. Main topics deal with properties and various applications of plastics. Well worth your while.

• Still looking for abstracters for "Plastics Around the World" feature of the Journal are: Osterreichische Plastic Rundschau, in German, and Ajour SNI, in Norwegian. No pay, but lots of satisfaction in contributing to the over-all welfare of the plastics industry.

• Several interesting looking books slated for early review in this Journal are: Plastics Progress 1953, published by Iliffe of London; Plastics Molding Engineering by Freund; and Organic Protective Coatings, edited by Von Fischer.

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Write The English Mica Co. . . . of 79 Prospect Street, Stamford, Connecticut for information on the Finer Ground Micas and U.S. Mica Co., Inc., Jordan & Van Dyke Streets, East Rutherford, N.J. on the coarser Ground Micas.

Your National Office

"**See you in Toronto!**" is becoming the watchword throughout the industry. In the past three months your Executive Secretary has been "on the road" for 8000 miles visiting eight more sections; a joint Eastern New England and Rhode Island and Southeast Massachusetts meeting, Southeastern Ohio, Philadelphia, Central Ohio, Newark, Chicago, and Cleveland-Akron. And the enthusiasm about the SPE Conference is really great.

The Newark Section expects to have their own railroad car and take a leisurely overnight trip to the Conference. I know many of the New York Section members are making a faster trip—only two hours—by plane. New England, being especially close to the Conference, promises strong representation. The Buffalo, Ontario, and Quebec Sections are looking for almost 100% attendance and Cleveland, only an hour away by plane, should come close to that. Philadelphia and Chicago expect attendance by their section members to be as good as it was in Boston. And the great state of Ohio will be well represented. Pittsburgh will be attending as a section for the first time and two more new sections should be accepted into the Society at the Conference.

Almost 300 have already registered for the Conference. What is especially noticeable is the number of men bringing their wives this year. The very interesting ladies program is one reason no doubt. One member telephoned to ask if taking his whole family would be practical. It will be the first time his children will have been outside the borders of the United States. There will be sight seeing tours, luncheons, even a fashion show—and a television interview of some of the distinguished speakers at the Conference is planned which many will want to attend. The annual banquet will be held and this year arrangements have been made for Conference guests to join the regular Friday evening Toronto nightclubbers at the Royal York Hotel for dancing afterwards.

The program of technical sessions at the Conference is just as essential to its success as is the program of your local section meetings for their success. From the comment of members throughout the country, in all phases of the industry, it would seem the Conference Committee has hit on subjects of current interest and the discussion of which will contribute to the progress of the plastics industry by making technical information available to the individuals in the industry.

Two misunderstandings should be cleared up. **Nonmembers as well as SPE members are welcomed at the Conference.** All can register at the Conference, but better accommodations are likely to be obtained by registering in advance.

Personally, I am looking forward with great pleasure and expectation to again being with the many friends I have made in recent months and meeting individually everybody at the Conference—see you in Toronto!

P. L. Underwood

Executive Secretary

How many will break?

Just three of these tumblers, out of a hundred dozen, were broken in a full year of service at the La Rue Carter Hospital for mental health in Indianapolis.

They're "Crystalon" tumblers, made from BAKELITE C-11 Plastic—an improved, tougher, stronger material that drives breakage costs 'way down.

Their appearance is long-lived, too. They don't chip. Their crystal clarity is an inherent feature of BAKELITE C-11 Plastic. Their tapered shape is just right for stacking; light weight makes them easy to handle.

These tumblers can be washed in automatic dishwashers at temperatures as high as 180 degrees F. BAKELITE C-11 Plastic withstands contact with soaps, detergents, oils, food chemicals, coffee, tea, citrus peels, and cosmetics. "Crystalon" tumblers are made and distributed by International Molded Plastics, Inc., Cleveland, Ohio.

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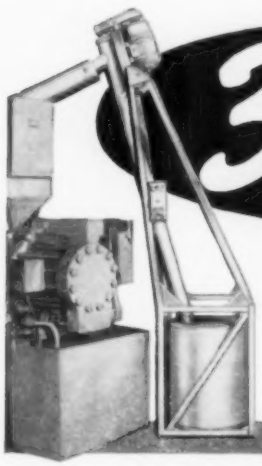
Section Membership Competition

Goal: Membership of 5000 by October 1, 1954

SECTION	MEMBERSHIP Oct. 1, 1953	NEW APPLICANTS Nov.	Oct.	% Increase
Baltimore-Washington	49	1	0	2
Buffalo	65	3	1	6
Central Ohio	33	0	1	3
Chicago	315	7	10	5
Cleveland-Akron	148	10	4	7
Connecticut	86	1	5	7
Detroit	173	6	0	3
Eastern New England	132	1	1	2
Golden Gate	32	3	2	16
Miami Valley	102	1	1	2
Newark	321	9	17	8
New York	248	1	17	7
Northern Indiana	21	1	0	5
Northwest Pennsylvania	75	4	2	8
Ontario	46	3	14	37
Philadelphia	174	6	0	
Pittsburgh	6	3	4	11
Quebec	25	5	2	9
Rhode Island & S. E. Mass.	68	2	2	
Rochester	65	4	3	1
St. Louis	71	0	4	
Southeastern Ohio	36	0	4	1
Southern California	96	6	7	1
South Texas	32	5	0	2
Toledo	59	0	0	
Upper Midwest	54	4	1	
Western New England	135	7	8	1
Non-Section	37	0	3	
TOTALS	2704	93	113	



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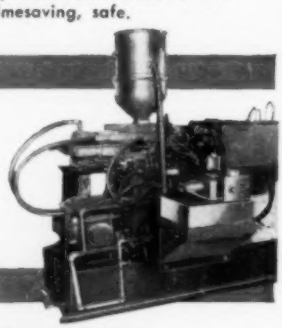

2 Hopper Dryer

For continuous drying and pre-heating of material. Easily installed on all standard makes of injection and extrusion machines. Saves handling—saves space—speeds production—economical to operate.

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Positive control of mold temperatures at constant level between 100-400 degrees F. Fast-acting electric immersion heaters in tank. Economical, simple to operate; mounts on wall or on machine. Stand optional.

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RATTY TRICK

It's a typically ratty trick, but four Minneapolis long-tailers are ratting on all their brother rodents.

They've been hired by a manufacturer there to determine if a new type of plastic will be too attractive to hungry rats. (One problem with plastics is that some types have proved unusually appetizing to these critters.)

Even a well-fed rat couldn't turn down the deal offered by the Minneapolis-Honeywell people: Two of the long-tail rodents enjoy one good ratfeed a day, plus after-dinner plastic to gnaw on. The other two rats get short rations but are served all the plastic they can eat. To top it off, one rat from each group gets food served right on his plastic!

So far, only one member of the genus rattus, the one on short rations who is served his plastic a la mode, has proved that a rat will damage the new plastic.

People—Honeywell testing laboratory technicians—are trying to see how far he will go. If he turns gourmand and shows he really likes their plastic, they'll mix a nasty repellent in it.

Making the mold from a block of wood. Since the only stress applied in the vacuum forming plastics is atmospheric pressure, costly machined dies are unnecessary.

Vacuum Forming of Polystyrene Sheet

John M. Hoy

The Dow Chemical Co.

THAT SEGMENT of the plastics industry which directs its energies toward the fabricating of plastic parts from flat thermoplastic sheet is certainly not new. However, due to certain restricting factors, economic and otherwise, it has not progressed proportionally with the plastics industry as a whole. There are several good reasons why sheet fabrication has lagged behind. One of the most retarding factors has been the comparatively high cost of sheet material. Actually, the other impediments hinge directly on this cost factor.

Approximately a year and a half ago The Dow Chemical Company made available to the plastics industry a rigid high impact thermoplastic sheet material. The inherent toughness, good dimensional stability and low water absorption of this sheet was of immediate interest to the sheet fabricator and led to its adoption for the production of many useful articles. This material was priced low enough to allow sheet fabricators to venture into fields where plastic sheet could not previously compete. This has been a strong stimulus to the sheet fabrication industry.

There are several methods by which sheet and similar materials may be fabricated. At the present time, however, vacuum forming seems to be the most popular.

The major advantages which vacuum forming offers include such factors as low tooling cost, a comparatively low capital investment, versatility of equipment to large or small parts and/or quantities as well as ability to mold large area thin section parts.

Vacuum forming may be accomplished by one of two methods. The plastic sheet may either be drawn over a male form or into a female form and in some operations it may be desirable to use a combination of both. There are, as a rule, definite advantages to be gained by employing one method or the other, depending upon the particular job.

One of the important advantages of using a male mold is that it is possible to achieve more even distribution of material in the lower sections of the formed part. This technique is commonly referred to as plug and ring forming. The essentials of vacuum forming with a male plug and ring are as follows:

The plastic sheet is clamped in a frame which in most cases is stationary. The sheet is then heated to the proper forming temperature and the plug is forced under pressure up into the hot sheet. This pre-stretches the material allowing it to freeze slightly on the bottom radii and remain thicker. When the mold base flanges on the clamping frame, it seals the sheet, and at this point the vacuum is drawn, bringing out the detail of the mold.

When using the plug and ring technique, the maximum detail is obtained on the inside of the formed part. For some deep draw applications it is necessary to have the maximum detail on the outside of the part. To accomplish this both a male plug and a female mold are used. The procedure is much the same as before, however, the vacuum is drawn on the female cavity rather than on the male plug. The plastic to mold contact is therefore on the outside of the formed article.

Section thickness of formed parts is directly proportional to the depth of draw. Consequently, the depth limitations on such parts will depend upon the required wall thickness, the total projected area, the gauge of the sheet used, and the geometry of the finished article.

For applications where the depth of draw is not too great, it is not necessary to pre-stretch the plastic sheet. Therefore, a straight vacuum draw into a female cavity is sufficient. The utilization of female molds has several advantages which makes their use more acceptable for certain applications.

For multiple cavity operations, where several parts are to be formed in a single draw, the female mold is more satisfactory. The reason for this is the fact that more parts may be obtained from the same area of sheet. For example, if a multiple piece mold were constructed using male plugs two inches high, it would be necessary to place the individual plugs two inches apart to prevent webbing between each part. Whereas in using multiple cavity female molds the individual cavities need only be far enough apart to allow for trimming.

Vacuum forming into a female mold also has the advantage of being generally simpler machine-wise. The mold is usually stationary and involves merely framing the sheet above it, heating, and drawing. Female molds may be constructed so that the mold itself, with the exception of the heat source, is the complete forming unit. This is accomplished by fastening the clamping frame

Operator placing sheet of Styron sheet in vacuum forming machine where in a matter of a little more than a minute it will be transformed into the sealed box containing the mold, heat is applied until the plastic becomes soft and pliable, then a vacuum is applied drawing the sheet tightly around the mold.

Rough drawn tray immediately after vacuum forming. Since this is an experimental model, the machine was not adjusted to eliminate waste of sheet.

Finished model after trimming excess sheet from edges. With such easily-made molds changes or complete new designs can be made quickly and inexpensively.

on the top of the mold and constructing a vacuum chamber below the mold cavity.

Because low pressures and relatively low temperatures are employed in vacuum forming, a wide variety of low cost, low strength mold materials may be used. Furthermore, the fact that molds are made with one surface decreases the time required for their construction.

Due to the fact that low pressures are used, machine construction is simplified. Consequently, the size and cost of equipment is considerably less than injection or compression molding equipment of equivalent capacity.

Another important factor is the versatility of equipment. The construction characteristics of vacuum forming equipment permit relatively large or small molds to be utilized. This makes it possible to produce parts in a variety of sizes with one piece of equipment.

Short production runs are practical for vacuum forming. Low tooling costs coupled with the comparative speed of tooling make short production runs feasible which could not be considered for an injection molding application. This method is also practical for the development and testing of models and prototype parts that are inherently suited for injection molding or extrusion.

When employing vacuum forming techniques it is possible to combine large projected areas with thin wall sections. Since section thicknesses of .020" and less are readily attainable in sheet forming work, plastics can economically compete in more markets.

In general, the essentials of a vacuum forming machine are the heat source, vacuum equipment, the clamping frame, and the mold platform.

A uniform source of heat is one of the first requirements. Radiant type heat applied from one side of the sheet has proven to be very satisfactory. However, this type of heat is limited to sheet thicknesses of less than ¼ inch. The important considerations when obtaining a heater are range of temperatures and uniformity. The forming cycle time will be influenced directly by the temperature of the heater. Proper material distribution, on the other hand, will function as a direct result of uniform heating.

Vacuum requirements will depend entirely upon the volume of air to be evacuated. One of the most important factors for the achievement of optimum forming results is the speed of draw which should be two seconds or less. If the drawing time is greater than two seconds, section thickness in the lower radii will be decreased. Polystyrene sheet is ideal for rapid vacuum forming, since it does not tend to "snap back" as many other plastic sheets do. The speed of draw hinges directly upon four factors: The placement of the vacuum ports in the mold, the diameter of the vacuum line between the mold and the vacuum tank and the size of the tank, and the pump capacity. These requirements may be computed directly from the following known factors: cubic area of the mold cavity and the two second drawing time. The necessary vacuum pump capacity may be figured from the volume of the mold and the speed of cycle.

The construction of equipment as to the placement and movement of its various constitutents is optional. These factors will be influenced greatly by the end use of the machine. The tendency throughout the industry, however, is toward increased speed and simplification of operation. As the cost of plastic sheet material decreases, labor must decrease proportionally. To achieve this, equipment must be designed eliminating excessive handling, which in the past has gained plastic sheet fabrication the

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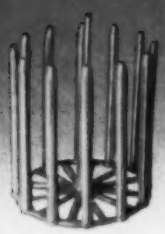
PENCIL CAVITIES HOBBED IN SOLID STEEL



MOLDED PIECES

HOBBED CAVITY

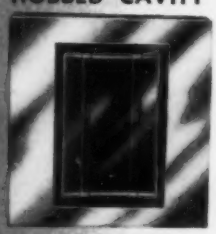
HOBBED CAVITY CUTAWAY VIEW

SKILLED HANDS *AND* GIANT PRESSES

combine to turn out consistently accurate hobbed cavities

HOB

HOBBED CAVITY



HOB

HOBBED CAVITY

Of course, Newark Die Hobbing and Casting Co. operates a battery of high-capacity presses—up to 3,000 tons—for the making of hobbed cavities.

But even more important than the number and size of hobbing presses is the skill and experience of the craftsmen who operate them. Without this know-how, *a costly hob can be ruined in seconds!*

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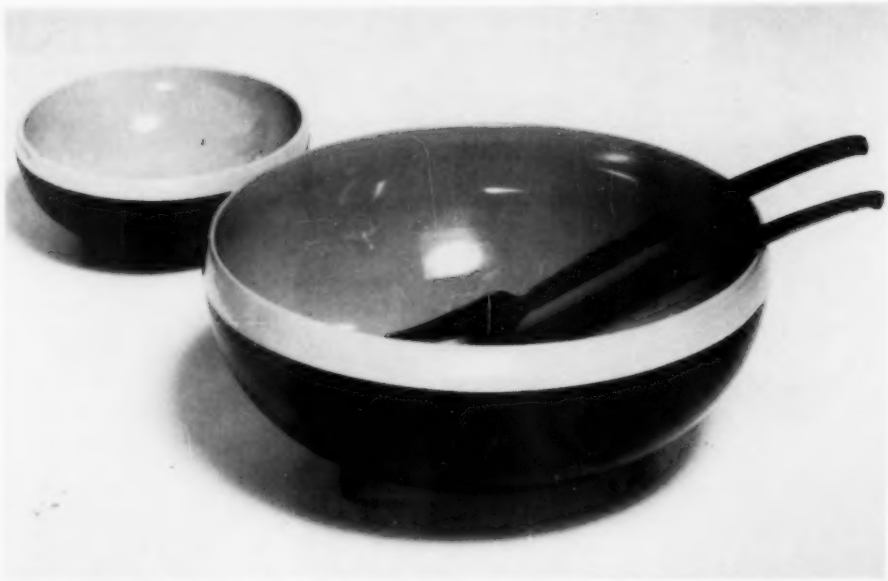


Thermo-Bowl Set created for Federal Tool Corp., Chicago, Ill. Polystyrene salad bowl molded in two pieces with air space sealed between. Available in various color combinations. The outer portion is a satin finish obtained by sandblasting the mold. Individual salad bowls to match. Salad fork and spoon in polystyrene of the same color as outer portion of bowl.
Beauty, smartness, and utility were the guiding considerations in the design of these bowls. Conceived to meet the demand of the housewife for distinctly "high-styled" household objects, the thermo-bowls also meet the manufacturer's requirement for mass production at moderate cost.

Cup holder designed for the Solo Cup Company, Chicago, Illinois. Economy was the principal consideration in the design of this polystyrene cup holder. Shape is dedicated to the feel in the hand and designed to bring the cup up higher in the holder to provide better gripping.

Plastics and the Industrial Designer

By
Jean O. Reinecke

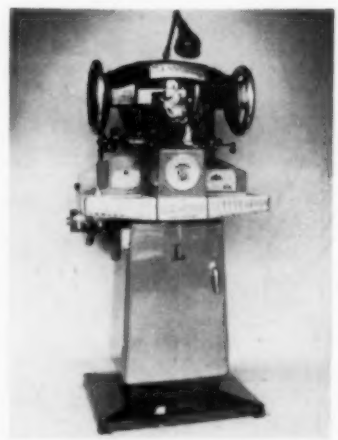
THE PAST QUARTER of a century has witnessed a phenomenal growth of two closely allied, but separate and distinct facets of American industry. One is the field of plastics, the other is the relatively new profession of industrial design. Through the past few decades, plastics and industrial design have experienced tremendous development and today both enjoy a high place in the industrial structure of the United States.

Probably one of the greatest single factors in the swift adoption of this versatile material is that it came into prominence contemporaneously with the growth of the production of industrial design. The creative designer finds great appeal in plastics since its many attributes make it almost the answer to the designer's dream.

Because of its endless and diversified potentialities for use in industrial design, plastics were enthusiastically adopted by the industrial designers of the nation from the very beginning. When the stylists first encountered this material, over twenty years ago, it was utilized principally as subordinate design pieces. During this period, the plastics industry was not even in its infancy, but in its fetal stages, alive and growing, but not quite developed and almost amorphous.

Long before plastics made its greatest progress in techniques, design, and equipment during the second World War, the professional stylists were familiar with its in-

Motorola clock radio designed by Reinecke has phenolic case, diecast bezel and handle trim in pink gold and gold colored perforated and incised metal grill.



J. O. Reinecke & Associates redesigned the cover of the Landis Aristocrat. Previously made of cast iron, it was changed to phenolic cover to achieve lighter weight, better finish, sound deadening at a lower cost. The design required an appearance character qualitatively in keeping with the reputation and technical excellence of the client's product.

About the Author

J. O. Reinecke

Jean Otis Reinecke, head of the Chicago product styling organization, J. O. Reinecke & Associates, is one of the nation's leading industrial designers and possesses a gifted insight into what Mr. and Mrs. America will buy. A pioneer in the field of industrial design, Jean Reinecke has had over 17 years of active participation in the design field and hundreds of household products from radios to refrigerators bear his styling imprint.

During the past year, he has served as president of the Society of Industrial Designers, one of the nation's foremost design organizations made up of leading industrial designers. In October of this year, Jean Reinecke was appointed Chairman of the Board of the Society of Industrial Designers

Jean Otis Reinecke has long been identified with plastics and plastics design. In past years his company has won many awards for its plastics products in a wide range of classifications. He is recognized by technical men throughout the country as an expert in the designing of products in plastics. He has been a member of S.P.E. for many years.

herent qualities and were making constant application of this material.

Much of the credit for this must be directed to the pioneers of the plastics industry who, during this "growing-up" period, realized the value of the industrial designer and set out to educate the stylists in the use of their product.

Because the material manufacturers and custom molders of this early period were aware of the value of design and undertook to enlighten the designers, plastics were receiving the benefits of styling almost from their very inception.

When most engineers considered plastics as a mere substitute, being unfamiliar with the many valuable characteristics of this material, the industrial designer was gaining the reputation of being a plastic expert because he was talking about phenol-formaldehyde and methyl-methacrylate. This, in a period when there was only one page devoted to the whole plastics industry in the Machinery Handbook.

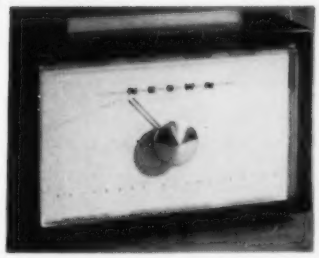
From the very beginning, plastics, more than any other material, permitted the consultant industrial designer to work hand in hand with industry in the styling of more functional and better appearing products. The designers were among the first to realize that here was a material which most nearly meets all the requirements of structure, fabrication, and appearance.

However, both the designer and the plastic manufacturers themselves will admit that plastics are not a panacea to relieve all the production ailments of industry. Its greatest attribute is that it possesses many of the intrinsic qualities which have been lost sight of after the conversion from handicrafted to machine-made products.

In discussing today's plastics, one fact stands out—here is a material capable of still greater accomplishments. Plastics are just emerging from the throes of their development stage. Twenty short years ago many of the products being constructed today of this material would have been virtually impossible. The future holds promises of even greater things.

There are many reasons why the plastics industry has experienced such an unprecedented expansion in the last twenty years. But the principal factor for its tremendous growth is the public's desire for plastic products and not for the plastic materials themselves. Industrial designers, who are ever-conscious of trends, although in reality they are actually the creators of trends through

Model T-10 "Tenna-Rotor" control of the Alliance Mfg. Co., before redesigning by Reinecke & Associates.



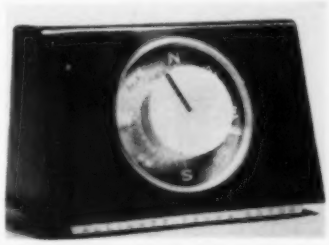
Model T-10 "Tenna-Rotor" control, redesign of outmoded model. Created by Reinecke & Associates for the Alliance Mfg. Co., Alliance, Ohio. Case of phenolic. Switch is a molded bar of milk white acetate. Satin silver dial printed in black with red accent. Pointer and pointer cover gold finish. Molded polystyrene crystal.
The new design is compact, thin and easily read. Downward pressure on the switch prevents sliding of unit in use. Former model was bulky, used two side action switches and had poor legibility. Designed to give it consumer appeal while offering a style easily adaptable to the decor of the modern home.

their designing, are well aware of the public's wants and needs. That is why, in so many cases, they have joined forces with plastics.

The industrial designer of today is a man of many talents. Besides being an advisor to industry, physician to sales-sick products, and counsellor to manufacturers, he is an individual who must combine his natural artistic ability with vision of tomorrow and a mechanical under-

(Please turn to page 34)

Model U-83 "Tenna-Rotor" control of the Alliance Mfg. Co., before redesigning by J. O. Reinecke & Associates.



Model U-83 "Tenna-Rotor" control, redesign of outmoded model. Created by Reinecke & Associates for the Alliance Mfg .Co., Alliance, Ohio. Size of cabinet was reduced. New dial features gold bezel, edgelighted transparent plastic crystal with three dimensional letters and incised aluminum background. Knob is off-white plastic with gold pointer insert. Brass base carries name in white.
This "Tenna-Rotor" control was designed to give it consumer appeal without sacrificing recognized materials and mechanical operation. It offers a style easily adaptable to the decor of any income home.

Raymond B. Seymour

Practical Indices for Chemical Resistant Plastics

Raymond B. Seymour

Executive Vice-President
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IN SPITE OF POPULAR misconceptions, the most important application of plastics is not for the production of novelties but for industrial uses. A large volume of plastics is already consumed by the aeronautic and automobile industries and there is a definite trend towards using larger amounts of plastics in corrosion resistant construction.

The principal end uses of chemical resistant plastics as coatings (1, 2), linings (3, 4), cements (5,6), jointing compositions (7, 8, 9) and plastic structures (10, 11, 12, 13) have been discussed quite thoroughly. In addition to application data which have appeared in manufacturers' catalogs and bulletins, information is also available on standards and specifications which have been established by committees of the National Association of Corrosion Engineers, American Society of Testing Materials and the Society of the Plastics Industry. However, because no readily understood data are available for comparing plastic materials, the design engineer has not been able to select plastic materials of construction with confidence.

Information on economics, specific gravity, structural strength, impact resistance, temperature limitations and resistance to solvents, salts, alkalies, acids and oxidizing agents have been published (15) but no simple method is available for comparing the physical and chemical properties of plastic materials. In the following chart which has been prepared in an attempt to supply this need, approximately thirty plastic materials, commonly used for chemical resistant construction and non-plastic products have been graded on five physical and five chemical properties. Relative values from 1 to 10 have been assigned for each physical and chemical property.

Thus, a summation of the first five values for any specific material will yield a grade for physical and practical properties. A summation of the last five values will supply an index of the overall chemical resistance of any specific plastic material of construction. Obviously, the ideal plastic should yield a value of 50 for practical properties and 50 for chemical resistance properties. Such a plastic would be relatively inexpensive, would have a low specific gravity, would be strong, and possess good resistance to physical damage and temperature. It would not be attacked by organic solvents, salts, alkalies, acids and oxidizing agents.

Obviously, the plastic material of construction that will have an index of 100 has not been developed. However, as will be seen from a review of the chart, some of the most chemical resistant plastics have values greater than 35 for chemical resistance and some of the better known materials of construction have values for practical properties varying from 30 to 40.

As a general rule, an attempt should be made to select a material having a total value for practical index above 25 and chemical resistance properties above 35 when the structure will be subjected to corrosive conditions. Compromises may be made with materials having lower indices when the low index values are not important in the application under consideration. However, when the summation of indices for either chemical resistance or practical values are low, the product should be examined very critically before being recommended as a material of chemical construction.

In many cases, it is permissable to accept low index values for practical properties in order to secure exceptional chemical resistance and low values for chemical resistance when the corrosive conditions are extremely mild. For example, polytetrafluoroethylene has a chemical resistance index of 50 and yet has a practical index of 24. Nevertheless, it should be considered for use in many cases where high chemical resistance is required in spite of a moderately low practical index. Likewise, steel has a low chemical resistance index value but because of its high practical index value of 35, it is often recommended when corrosion resistance is not the major consideration.

Some specific index values may be disregarded if the rated property is not important in the anticipated application. Thus, products like asphalt may be used for chemical resistance applications in the absence of solvents and oxidizing agents since the total index value for resistance to salts, acids, and alkalies is above 30. Likewise, when a structure operates at room temperature, and the total weight and economics are not considered important, the index values for structural strength and resistance to physical damage only should be considered. Thus, cellulose acetate-butyrate pipe finds many uses even though it has poor resistance to chemicals and temperature and is moderately expensive.

It must be recognized that methods of compounding and fabrication have considerable effect on both physical and chemical properties of commercial plastics. Even when the index values are high for the generic materials, properties of the commercial products must be considered. Admittedly, the indices, as given, are empirical and are

*Presented to the Institute of Chemical Engineers, Montreal, Canada—October 28, 1953.

PRACTICAL INDICES FOR CHEMICAL RESISTANT PLASTICS

	Cost	Sp. Gr.	Struc. Str.	Resis. to Phys. Damage	Resis. to Temp.	TOTAL PRAC. INDEX	CHEMICAL RESISTANCE: Solvents	Salts	Alkalies	Acids	Oxidation	TOTAL CHEM. RESIS.	TOTAL INDEX
Plasticized Sulfur	10	6	2	2	5	25	2	10	1	10	3	26	51
Polyethylene	7	9	3	10	1	30	5	10	10	10	7	42	72
Polyisobutylene	7	9	1	10	1	28	2	10	10	10	5	37	65
Asphalt	10	9	1	3	1	24	1	10	7	10	1	29	53
Coal Tar	10	9	1	3	1	24	1	10	10	10	1	32	56
Coumarone—Indene	10	9	1	4	1	25	1	10	10	10	2	33	58
Polystyrene	7	9	6	3	3	28	3	10	10	10	3	36	64
High Impact Styrene	7	8	6	6	3	30	3	10	7	9	3	32	62
Styrene-Acrylonitrile	7	8	6	4	3	28	4	10	6	9	3	32	60
Polymethyl Methacrylate	4	8	6	7	3	28	4	10	7	9	3	33	61
Moderate Impact PVC	5	8	6	8	3	30	5	10	10	10	7	42	72
Plasticized Polyvinyl Chloride	6	8	4	10	3	31	4	10	9	10	5	38	69
Vinyl Chloride Acetate Copolymer	6	8	5	6	3	28	3	10	7	9	4	33	61
Polyvinyl Butyral	3	9	4	7	3	26	3	8	6	6	1	24	50
Saran	5	7	7	7	4	30	5	10	7	10	6	38	68
Saran Rubber	6	7	4	8	3	28	3	9	3	9	4	28	56
Polytetrafluoroethylene	1	6	2	6	9	24	10	10	10	10	10	50	74
Silicone	1	7	3	7	9	27	3	5	4	3	1	16	43
Nylon	3	8	10	7	6	34	7	10	7	3	1	28	62
Natural Rubber	7	9	4	10	4	34	2	10	10	10	1	33	67
Butyl Rubber	7	9	4	10	3	33	2	10	10	10	6	38	71
Chlorosulfonated Polyethylene	3	8	4	10	4	29	3	10	10	10	6	39	68
Chlorinated Rubber	6	7	3	3	3	22	2	10	10	10	4	36	58
Styrene Rubber	7	9	4	10	4	34	2	9	10	10	1	32	66
Neoprene	6	8	4	10	5	33	3	9	10	9	1	32	65
Reinforced Polyesters	6	8	10	8	6	38	6	10	3	7	5	31	69
Phenolic Resin Cements	8	7	5	6	8	34	9	10	3	10	3	35	69
Epoxy Resin Cements	6	7	5	7	6	31	6	10	7	9	1	33	64
Furan Resin Cements	8	7	5	6	8	34	10	10	10	10	1	41	75
Cellulose Acetatebutyrate	4	8	4	7	3	26	3	7	2	2	1	15	41
Polyvinyl Acetate	8	8	3	7	3	29	2	2	2	2	1	9	38
Redwood	10	10	9	7	7	43	7	7	7	4	1	26	69
Oil Base Paint	9	9	1	2	3	24	2	5	1	1	1	10	34
Aluminum	7	5	9	6	10	37	10	8	1	2	3	24	61
Steel	9	1	10	6	10	36	10	2	5	1	2	20	56
Stainless Steel 316	1	1	10	6	10	28	10	9	7	4	8	38	66
Pyrex	7	6	5	1	10	29	10	10	2	9	10	41	70
Cement-Asbestos Board	8	6	4	6	9	33	9	8	5	2	1	25	58
Acid Brick	10	4	3	2	10	29	10	9	3	9	10	41	70

not recommended as a substitute for expert knowledge. However, the use of relative index values should be of considerable assistance in the preliminary selection of materials for chemical construction.

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Thermal Degradation of Polymers During Molding

Part I. Theoretical Considerations

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Syracuse University

and

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IN THE USUAL molding practice, a part of the charge in the cylinder consists of material heated in the course of the previous operation of the mold. This material consists of residue as well as scrap from the sprues, and the like, of the previous operation cycle (an operation cycle being the time between successive chargings of the cylinder). The material is heated in the course of the operation of the mold and will thus be subject to some thermal degradation. Since a fraction of the material is used repeatedly it is quite to the point to ask how much of the charge of the cylinder say after the n^{th} operation cycle (heating) has been degraded and to what extent. The extent of degradation may critically affect certain properties of the molded product as for example the color and mechanical strength.

Let M be the total mass of material in the cylinder equal to the mass of the molding plus the mass of the residue. Let [f = (i, n)] be the mass of material heated exactly i times after a total of n operations (heatings) in the cylinder before the start of the n+1st heating. The charge in the cylinder consists of a mass qM of residue left over from the previous heating plus the mass p (1 - q) M of the scrap from the previous molding plus a mass of (1-q) (1-p) M of fresh unheated "virgin" material added to the pot to make the mass of the charge M, i. e.

qM + p (1-q) M + (1-p) (1-q) M = M
residue scrap "virgin" = charge

Now from the definitions given:

$$M = \sum_{i=0}^{n} f(i,n)$$

with f (o , n) = (1-p) (1-q) M for all n.

Employing weight fractions rather than the masses themselves we can rewrite this letting

u (i , n) = f (i , n) / M,

$$1 = \sum_{i=0}^{n} u(i,n) = (1-p)(1-q) + \sum_{i=1}^{n} u(i,n)$$

At the start of each operation the ratio of heated mass to unheated virgin mass is as

-pq + (p + q) : (1-p) (1-q).

Now we have from the make-up of the charge before the n + 1st operation

f (1 , n) = q f (o, n-1) + p (1-q) f (o , n-1)

Since once heated material can only arise as a result of heating "virgin" material of the previous cycle we may divide by M and write

u (1 , n) = (q + p (1-q)) u (o , n-1)

Similarly for twice heated material we obtain the relation

u (2 , n) = (q + p (1-q)) u (1, n-1), etc.

and in general for values of i greater than zero and less than or equal to n,

u (i , n) = (q + p (1-q)) u (i-1 , n-1)
= a u (i-1 , n-1)

where a = (q + p (1-q)). Note that a lies between zero and one

, a = 1 if and only if q = 1.

This difference equation has to be solved under the conditions that

u (o , n) = (1-p) (1-q) = 1 - a , n greater than o and

$$\sum_{i=0}^{n} u(i,n) = 1$$

The solution of this difference equation is

u (i , n) = a^i (1 - a) for i = o, 1 , . . . , n - 1.

u (i, n) = a^n for i = n.

This can be readily seen from table I.

Table I. Composition of Cylinder

n	u(0,n)	u(1,n)	u(2,n)	u(3,n)	...	u(i,n)	...	u(n,n)	Sigma (from i = o to i = n) of u(i,n)
0	1	0	0	0	...	0	...	u(o,n)	1
1	1-a	a	0	0	...	0	...	u(1,1)	1
2	1-a	a(1-a)	a^2	0	...	0	...	u(2,2)	1
3	1-a	a(1-a)	a^2(1-a)	a^3	...	0	...	u(3,3)	1
...	...	...	...	...	...	...	...	...	...
i-1	1-a	a(1-a)	a^2(1-a)	a^3(1-a)	...	0	...	u(i-1,i-1)	1
i	1-a	a(1-a)	a^2(1-a)	a^3(1-a)	...	a^i	...	u(i,i)	1
...	...	...	...	...	...	...	...	...	...
n	1-a	a(1-a)	a^2(1-a)	a^3(1-a)	...	a^i(1-a)	...	u(n,n)	1

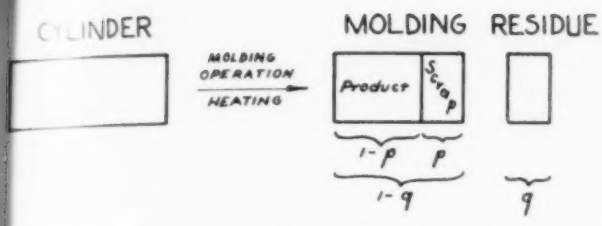

Figure 1. Illustration of mathematical terms: a molding operation leads to product plus scrap.

Using this solution we can find for example the fraction of material in the pot which has been heated at least s times after a total of n heatings and just before the $n+1^{st}$, v(s,n) , i. e.

$$v(s,n) = \sum_{i=s}^{n} u(i,n) = a^s$$

This is again readily seen from table I.

We can now ask what is H (n); that is, the mean number of heatings of a given aliquot of a cylinder that has undergone a total of n molding cycles and is just before its $n+1^{st}$ molding?

By definition

$$H(n) = \frac{\sum_{i=0}^{n} i\,u(i,n)}{\sum_{i=0}^{n} u(i,n)} = \frac{a}{1+a}(1-a^n)$$

Since a lies between zero and one, H (n) for large n approaches a/(1 + a) , i. e.

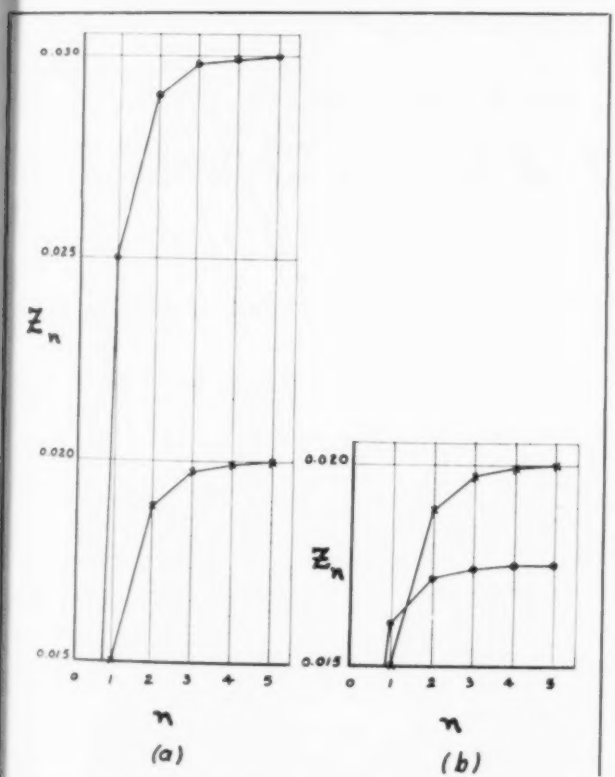

Fig. 2. The total fraction of thermally degraded material in the cylinder Zn as a function of the total number of heatings n; x-lines are zeroth order kinetics; dot lines are first order kinetics:
(a) $a = 0.25$, $k_o t = k_1 t = 0.1$;
(b) $a = 0.25$, $k_o t = k_1 t = 1$.

the limit approached by H (n) as n approaches infinity, is a/ (1 + a).

Consider now some physical property of the molding material which changes as a function of the heating time $t(i) = i\,t$ where t is the duration of a heating (molding) operation. Such a property is the fraction of material thermally degraded , $D(t\,(i)) = D(it)$.

For example the fraction of thermally degraded i-fold heating material which has undergone a total of n operating cycles is $D(i\,t)\,u\,(i,n)$. Thus the total fraction of material thermally degraded in the cylinder satisfies the equation.

$$Z_n = \sum_{i=0}^{n} D(i\bar{t})\,u(i,n)$$

We will consider several kinetic possibilities for this thermal degradation:

(a) Zero order kinetics

In this case

$$\frac{d}{dt}\,\frac{D(t\,(i))}{(i)} = k_o$$

which on integration gives

$D\,(t(i)) = k_o\,t(i) = k_o i t$.

Thus

$$Z_n = \sum_{i=0}^{n} k_o \bar{t}\, i\, u(i,n) = k_o \bar{t} H(n) = k_o \bar{t}\,\frac{a}{1+a}\,(1-a^n)$$

As n increases Zn approaches the limiting value

$$Z_{n\to\infty} = k_o \bar{t}\,\frac{a}{1+a}$$

(b) First order kinetics

In this case

$$\frac{-d}{dt}\,\frac{D(t\,(i))}{(i)} = -k_1\left[1 - D(t\,(i))\right]$$

which on integration gives

$$D(t\,(i)) = 1 - e^{-k_1 t(i)} = 1 - (e^{-k_1 \bar{t}})^i$$

Thus

$$Z_n = \sum_{i=0}^{n} \left[1-(e^{-k_1\bar{t}})^i\right]_{u(i,n)} = 1 - (1-a)\left[\frac{1-e^{-k_1\bar{t}}a^n}{1-e^{-k_1\bar{t}}\,a}\right] - e^{-k_1\bar{t}}a^n$$

As n increases Zn approaches the limiting value

$$Z_n = 1 - \frac{1-a}{1-e^{-k_1\bar{t}}a}$$

This illustrates how Zn can be calculated once $D(it)$ is known. In the case of polystyrene it is known that the kinetics of thermal degradation in vacuum follow a rate law intermediate between first and zeroth order, while for polyethylene the overall rate appears to be first order.[1] In the actual molding operation these rate laws would probably be modified in particular since air is not excluded during the operation.

In conclusion it has been shown that the amount of degraded material in the charge is asymptotically a function only of a the fraction of previously heated material and the kinetic rate law of the thermal degradation. The extent of degradation has been found for the case of first and zeroth order kinetics. In part II of this paper we will report the findings of an experimental study of this problem which is now in progress. We are indebted to Mr. M. D. Curwen, editor of "Plastics" who suggested this problem.

Abstracts of Papers

Tenth SPE Technical Conference

The Royal York Hotel — January 27, 28, 29, 1954 — Toronto, Canada

WEDNESDAY, January 27, 1954

Symposium on Modified Styrenes

Moderator: A. E. Byrne, Manager Chemicals Division, Canadian General Electric Company

1:45 Styrene-Acrylonitrile Copolymers. Dr. S. Whittaker, Bakelite Co.

Acrylonitrile can be copolymerized with styrene to give rigid, transparent materials that are substantially different from either polyacrylonitrile or polystyrene. The copolymers have higher mechanical strengths, better weather resistance and different chemical properties than polystyrene. They can be molded or extruded in conventional equipment and in this respect they differ from polyacrylonitrile. Incompatibility of the copolymers with polyacrylonitrile or polystyrene is further evidence of a true copolymer.

Resistance of commercial copolymers to foods, detergents, household cleaning solvents, oils, greases, low benzol content gasolines, battery acids, alkali and some cosmetics indicates a wide area of usefulness extending the scope of styrene homopolymers and alloys. Many copolymer applications require one or more of these chemical resistant properties plus the inherent toughness of the material.

Oriented copolymers in the form of stretched monofilaments exhibit the same improved mechanical strength, heat resistance, and weather resistance as molded copolymer shapes.

Low temperature mechanical data indicate a brittle point below -50 deg. F. Flexural strength and flexural work to break measurements to about -50 deg. F. show a continuing increase in these properties.

Comparative data charts and examples of molded objects will be shown to illustrate the areas where acrylonitrile-styrene copolymers are being used, and the relation of copolymers to other commercial materials.

2:05 Techniques and Applications of Modified Styrene Sheet (475). F. T. MacRae and W. D. Harris, Dow Chemical Co.

The introduction of modified polystyrene in sheet form has established a whole new field of plastics fabrication. The rapid growth of this field was made possible by the outstanding properties and realistic price of modified polystyrene sheet.

The bulk of modified polystyrene sheet is fabricated by the vacuum forming process. The sheet, clamped in a frame and softened by heat, is pulled over a male mold or into a female mold of the desired shape. A blanking or trimming operation completes the fabrication of the part. The vacuum forming process may also be applied to hot, continuously extruded sheet.

The relatively low initial cost of fabricating equipment and the very low cost of making vacuum forming molds from a number of materials such as Kirksite, aluminum, and thermosetting plastic resins make the field of fabrication attractive for many uses. The refrigeration and television industries are large consumers of modified polystyrene sheet.

Research for new, more versatile sheet materials and the introduction of new fabricating equipment and techniques will continue to stimulate the growth of the plastic sheet fabricating field.

2:25 Applications for Rubber Modified Styrene Molding Compounds. E. D. Hellyer, Monsanto Chemical Co.

First used in the novelty field, primarily because of their low cost, styrene molding compounds are now recognized in industry as engineering materials, selected for their own inherent properties.

The introduction of rubber modified styrene molding materials approximately five years ago has resulted in an over-all expansion of the total styrene market. The modified styrenes possess many of the desirable properties of the general purpose materials, such as excellent dimensional stability, low specific gravity, uniform physical properties and ease of moldability. In addition, they possess strength characteristics necessary in industrial applications.

Rubber modified styrenes are widely used in industrial applications such as refrigeration, air conditioning and automotive battery cases. They are also rapidly replacing general purpose styrene in housewares and toys. It is essential that consumer resistance to plastic toys be overcome by the use of impact materials if the industry is to successfully counteract inroads currently being made by metals in this field.

Development of large injection molding equipment has contributed much to the growth of rubber modified styrenes. Extrusion of high impact sheeting for vacuum forming offers a tremendous potential for use in refrigeration, air conditioning, signs and displays and packaging.

Hand-in-hand with new developments and equipment new and improved rubber modified materials are being developed by the raw material manufacturers. We look for sales in impact styrenes to more than double over the next five year period, representing over 50% of total industry sales of all types of styrene molding materials.

2:45 "Kralastic" . . . a Polymer of Styrene-Acrylonitrile-Butadiene in Pipe Fittings. Paul M. Elliot, Naugatuck Chemical Division, U. S. Rubber Co.

3:05 Present and Future Applications of Heat Resistant Modified Styrenes. C. J. Snyder, Koppers Company, Inc.

3:25 Question and Discussion Period.

Why **More Plastics?** A. Renfrew, Imperial Chemical Industries, Ltd.

[illegible]ics at present in common use suffer from many [illegible]ages. The upper temperature at which they can [illegible] is low and few will withstand 250 C. Most [illegible] are non-ductile and cannot yet be manipulated as [illegible] as quickly as metals, although great strides have recently been made on the engineering side of the [illegible]. Many plastics have a poor resistance to weather-[illegible].

Another disadvantage of plastics is their cost, and the newest ones sell at dollars rather than cents a lb.

In the immediate future very large tonnages of well known plastics such as polystyrene and polyethylene will be required so there is no commercial pessimism.

Growing industries will present new problems which only plastics can solve. The fibres industry has already been given "Terylene" and polyacrylonitrile, and the aircraft industry several unusual plastics. The electronics industry is always seeking new products for its highly specialized applications. "Terylene" film is a good example.

Most of the new plastics have a carbon chain skeleton with sometimes nitrogen and oxygen atoms. The side chains show greater variety and all the common elements have been utilized.

It is true that Beilstein has not been mined completely nor have the speculations of Staudinger or Carothers been fully exploited. New and commercially important plastics may therefore arise from developments along familiar lines but there seem to be no revolutionary technical thoughts.

There is undoubtedly a need, however, for new plastics. The present trouble of the chemist is to imagine how these needs may be fulfilled.

THURSDAY, January 28, 1954
Session A

Moderators: R. Kellam, Hydro Electric Power Commission of Ontario, and Frank Reinhart, National Bureau of Standards.

9:00 **Automatic Injection Molding.** Ernest Moslo, Moslo Machine Co.

9:30 **Accessory Equipment Required to Injection Mold Quality Pieces.** Walter E. Rahm, Boonton Molding Co.

10:30 **Marking and Decorating of Plastics.** Arthur N. Skeels, Art Roll Leaf Stamping Co.

The talk will cover nearly all the methods of decorating and marking of all types of plastics, such as the hot stamping process wherein procedure, material, availability of equipment and approach to same will be outlined. Also, silk screening procedure along with the pitfalls involved as well as the use of paper equipment and materials.

One of the main highlights of the talk will be directed to the mold design engineer with regard to that which they should look for prior to the actual making of the mold so that costs for decorating and time elements can be held to a minimum provided proper thought is given to the design of the product in the initial stage which would encompass a marking or decoration in the final analysis and avoid many of the pitfalls that befall the decorating or marking of the product. I will give some very helpful hints as to what to look for in this respect and improve the appearance of the product from the standpoint of the general buying public as well as show the economies which can be effected.

11:15 **The Extrusion of Thermoplastic Film and Sheeting.** George P. Kovach, Foster-Grant Co.

Various methods for the forming of thermoplastics into Film and Sheeting are discussed and the advantages of extrusion over other methods are pointed out. The difference in investment and manufacturing time between the extrusion of cellulose acetate sheet and its manufacture by the old block method is shown.

Other reasons for the fast expansion of film extrusion are:

1. The growth of polyethylene packaging film.
2. Styrene sheeting for vacuum forming.

The newest addition to the extruded film family is plasticized P.V.C. The advantages of extruded P.V.C. Film over Calendered Film are shown.

Next the various methods and techniques of film extrusion are discussed, dividing the field first into,

a. rigid sheeting.
b. flexible film and sheeting, and on the other hand into flat and circular extrusion.

Various factors influencing the rigid sheet extrusion are discussed.

a. preparation of stock.
b. screw design and heating method.
c. die design.
d. take-off methods.

Next the extrusion of polyethylene film is described

E. D. Hellyer

Paul M. Elliott

T. J. Martin

R. Hauter

Frank Reinhart

J. H. Shipley

H. A. Gadd

W. D. Todd

in detail as to methods and problems involved.

Finally the extrusion of plasticized P.V.C. is described from all aspects as formulation, preparation of stock, methods of extrusion, and future outlook for this field. Both flat film extrusion and circular blow extrusion are described in detail, and advantages and disadvantages are evaluated.

Slides are presented showing circular and flat film dies, extrusion of blown film, including the take-off mechanism and tables showing a comparison of some physical properties of calendered and extruded P.V.C. film.

Session B

9:00 The Plastics Industry Challenges Educators; annual Forum on the Education of the Plastics Engineer. Organized by J. W. Lindau, III.

Future Growth of the Plastics Industry. Harry A. Gadd, Canadian General Electric Co., Ltd.

Synthetic plastics is a growth industry. Included as it usually is with Chemicals—it is also a member of a growth family. Curves by slide projection will show plastics history growth 15% annually over the last 25 years, and 20% per year over the last 17. Growth was continued through the depression period from 50 million dollars in 1930 to 90 millions in 1935 and to 180 millions in 1940.

Raymond H. Ewell, Stanford Research Institute, has projected the historic record conservatively to show an increase over the next 22 years from 800 millions in 1950 to 8 billions in 1975, an annual average increase of just less than 10% based on 1950 values. Mr. Ewell's approach appears conservative because if the growth of the past 25 years were projected directly, the 1975 figures would be 26 billions rather than the 8 billion dollars shown. Performance since the issue of Mr. Ewell's report generally confirms this projection.

Plastics materials development and manufacture is generally scientific. Application and fabrication by molders and processors is to date in the art class and deplorably lacking in science. Fractional progress has been made but the history of other industries shows that maturity and success are linked with scientific control and achievement.

It follows that qualified people of specific technical and scientific training are required. Present graduate courses (in most colleges) do not satisfy. Some suggestions will follow from the molders viewpoint as to specific training requirements and actual avenues of scientific advance required in plastics.

Industrial Interests in the Education of Plastics Engineers. R. C. Bartlett, Natvar Corp.

During the past year opinions of industry on the Society of Plastics Engineers Educational Program have been acquired by means of a questionnaire. Answers received, cover the plastics industry in broad point of view. The plastics industry strongly favors the present SPE program for education of plastics engineers. In addition to the information requested in this questionnaire, other helpful facts have been uncovered by statistical analysis of the answers. This survey demonstrates the industrial interest in plastics engineers and may aid the educators in tailoring their curriculum to this demand.

11:20 Plastic Material Problems in Power Production. B. Kellam, Hydro Electric Power Commission of Ontario.

The paper outlines the activities in plastics of one of the largest electrical utilities on the continent, and gives details of three subjects to illustrate the problems and attempts to solve them. The first is the development of a plastic cable-fastener for supporting vinyl-insulated control cables in a vertical position and one that avoids cold flow. The stages in the development and the result of tests simulating operating conditions with long vertical cables suspended on them are given. The second subject involves the experiences with polyethylene as a wire insulant used in a very large 4000 volt network. Failures at joints and some due to environmental cracking are detailed, with results of improvement in technique and materials. Experiences with the melt indexer are given. Finally, plastic pipe is dealt with, for water supply, electrical conduit and a special application in high-voltage power transmission. Some of the factors involved in the evaluation of plastic pipe for these applications are given. Twelve illustrations.

THURSDAY, Afternoon

Moderator: J. H. Shipley, Canadian Industries Ltd.

1:45 Polyester Resins and Their Industrial Applications. Irving E. Muskat, Celanese Corp. of America.

Synthetic resins and plastic materials are usually classified as (1) naturally occurring high molecular weight materials, (2) thermoplastic resins, and (3) thermosetting resins. Classes 2 and 3 are further divided into those resins which are cured by condensation reactions and those cured by polymerization reactions. Polyester resins, often called "low pressure" or "contact pressure"

...long in the group of polymerizable thermoset-... They give off no volatile by-products and ... is required in curing. The two types of poly-... which are commercially available are those ... the polymerizable groups are in the alkyl part ... in which the polymerizable groups are in acyl ... the molecule. The rest of this discussion will be ... the latter or unsaturated alkyd type resins.

Optimum properties and workable viscosities are ... by using a monomeric mono-functional resin, ... styrene, vinyl acetate, or methyl methacrylate, as ... polymer. Monomeric poly-functional resins such as ... diallyl-phthalate may also be used as a co-... Although all of the above co-polymers are ... monomeric styrene is usually preferred since the ... properties and ease of handling are considered ... superior. The concentration of co-polymer used ... on the type of resin, working viscosity, and ... desired. Recently developed polyesters give ... properties and are compatible in all proportions.

... and specific properties such as high-heat re-..., fire resistance, toughness, etc. can be obtained ... the use of fillers.

Polymerization of these resins is effected by means ... any of a large number of peroxides and hydroper-... Each of these peroxides is most effective in differ-... temperature ranges which correspond fairly closely ... the thermal decomposition point of the peroxide.

Peroxide catalyzed polyester resins can be cured ... through the application of heat or by means of ... temperature accelerators. No pressure is required ... no volatile by-products are produced.

Polyester resins including a new thixotropic resin ... been used to produce a great variety of products ... means of many different production techniques. Some ... the production methods are compression molding and ...molding. The Marco Method for making boats will be ...monstrated as well as casting and the use of Marco-...thix for the production of tanks.

2:25 Tool Steel for Plastic Molds. Hugo C. Becker, Crucible Steel Co. of America.

The talk is predicated on the basic hypothesis that the quality of a molded part is no better than the quality of the mold in which it was produced. Therefore, the production of a quality molded part, as pertains to the mold, is the successful combination of certain factors:

1. Mold steel quality and properties
2. Mold design
3. Mold building practice
4. Mold operating conditions

From the practical viewpoint of the mold builder, the three factors of importance concerning tool steels for plastic molds are their production, distribution, and application.

The general quality of any steel is governed by its method of production. The melting, forging, mill heat treating, and inspection practices will be discussed from the viewpoint of producing a tool steel of a quality suitable for plastic molds.

Once the steel has been produced, its value to the mold builder is nil; unless it is readily available in the ... required. In dealing with mold builders, we must ... under the basic distribution hypothesis that when ... ordered, the job is already a minimum of one day behind schedule. The prime problems of availability and delivery will be discussed in relation to standard stock sizes vs. special forgings, and steel locations vs. key demand areas.

When the steel has been produced and made available, its value to the mold builder is governed by the proper application of the steel within the limitations of its physical and mechanical properties. The available types of hobbing grades, master hob grades, and machine-cut grades will be briefly described, along with their application to compression and injection molds. Recommendations to mold builders concerning mold design, machining, heat treatment, and polishing practices, as concern the production of a high quality mold, will be discussed from the viewpoint of the steel maker.

In conclusion, key points will be reviewed briefly and the steel maker's views as to the future will be given.

3:15 Liquid Polymers Combined with Epoxy Resins. J. S. Jorczak and J. A. Belisle, Thiokol Chemical Corp.

3:55 Arcing Tests on Plastics. Thomas J. Martin and R. L. Hauter, Boeing Airplane Co.

Increasing concentration of electric power at higher voltages in the airplanes of today has made essential a review of the usage of insulating materials which, by their nature or their application, may constitute a fire hazard under abnormal conditions of circuit or equipment failure. Boeing's interest in this problem was stimulated by the occurrence of fires in the mockup of a new electrical system in which phenolic limiter blocks burned with sufficient violence to burn holes in the supporting structure.

It was found that power arcs across the surface of the material produced results which were somewhat different from those produced by the standard ASTM test method. A new technique was developed for testing the materials in the presence of sustained electrical arcing simulating a circuit failure.

A number of different materials have been tested, and tests are continuing for further evaluation of arc-resistant materials. The results of tests made to date which cover a range of materials from phenolics to glass-bonded mica and Teflon are included in this paper.

Results of these tests are quite spectacular and have been recorded on colored film. It is planned to present this film as a portion of the presentation of this paper.

This test program showed very definitely that the possibility of an electric power arc must be considered in choosing insulating materials, and that the phenolics, in particular, must not be used in locations where such arcing is possible.

4:35 Conclusion of Polyester Resins Papers.

7:00 Banquet Speaker, Dr. Emmett O'Grady.

"Levity and Learning in Literature" will be the subject of an address by Canada's Dr. Emmett O'Grady, professor of English, Ottawa University, at the 10th Annual Conference of the SPE in Toronto, Jan. 28. Dr. O'Grady, who will be guest speaker at the banquet, is a

brilliant young newcomer to the international lecture circuit. He is 35.

Dr. O'Grady admits to as great a preoccupation with levity as with learning. He says: "People have missed out on a lot of masterly wisecracks by avoiding the classics." He believes his collection of these is unique in our time. His major problem on the lecture platform is in timing his laughs to complete his address.

A milder example of classical with concerns Samuel Johnson. When told there was less flogging in the schools than there had been, he immediately pointed out that less was learned so that "what was gained at one end was lost at the other." Some of the more obscure witticisms don't look too well in print," he admits. "However, Johnson was usually in good taste."

Dr. O'Grady was a lieut. commander, RCNVR, in the war. He is married and has four children. His speaking engagements have taken him across Canada and to many parts of the United States. He is the founder and moderator of an annual series of radio discussions in Canada.

FRIDAY, January 29, 1954

Session A

Symposium on Extrusion

9:00 Dry Blending of Vinyl Compounds. M. S. Greenhalgh, General Electric Co.

The technique of extruding dry blend compounds made of polyvinyl chloride resins depends primarily on two types of processing equipment, namely the mixer or blender together with the extruder. There has been considerable controversy concerning these two phases particularly the latter. It is quite difficult to discuss the mixing equipment without taking into account in what manner the compound will be processed in the final operation. There are some who are of the opinion that if an extruder could be designed with better compounding or fusing action than the present type then the actual mixing of dry blend stocks would be considerably simplified.

In considering the type of extruding equipment which is now being used there are at least two additional items which must be taken into account. The first is the quality and production requirements of the product to be produced. The second is the type of formulation required to produce that product. In every day blend operation all these factors are dependent one on the other and none of them may be changed without affecting the overall set-up.

In many instances there have been numerous attempts to overcome certain objections to either the mixing or extruding process by altering within limits the formulations used. Everyone is quite familiar with the dry blending claims made by the various resin suppliers for their particular grade of resin. The question of how far the development of superior dry blending resins can be carried may be in the same category as the ultimate design of an extruder-compounder. The effect of other compounding ingredients such as plasticizers, stabilizers, fillers, etc. also must be considered in formulating for proper dry blend processing. From time to time there are reports that various processors have obtained better extruding results by using certain plasticizers in various amounts.

Therefore, in discussing the pros and cons of the numerous types of mixing or blending equipment we must bear in mind the extent to which the success of the operation is dependent on factors mentioned above.

9:30 Types of Extruders. Herbert O. Corbett, [illegible] Button Works, Inc.

I. **EXTRUSION MACHINES IN GENERAL.**
- A. Oil heated versus electrically heated.
- B. Machine drives. D. C. variable speed drives vs. mechanical variable speed drives. Mechanical step drives.

II. **SELECTING THE PROPER DRIVE FOR GIVEN CONDITIONS.**
- A. Job shop or custom extrusion vs. long range continuous production.
- B. Similar drives for interchangeability.
- D. Advantages and disadvantages of having a flexible machine drive.
- D. Long lasting, trouble free performance of machine drives.

III. **GOOD BASIC DESIGN IN TOOLING AN EXTRUDER.**
- A. Cellulosics and vinyls run from same basic design.
- B. Extruder die gate design.
- D. Design of tools for interchangeability between different size extruders and dissimilar makes of machines.
- D. Good approach design.
- E. Design to help eliminate trial and error methods to obtain a desired shape and be able to do it more than once.
- F. Simple die orifice design for confidence.
- G. Die orifice design so as to anticipate probable future shape changes.
- H. Can you save any part of it?

IV. **SUMMARY AND ACKNOWLEDGEMENTS.**
- A. Conclusive direction in extrusion machine selection.
- B. Designing extrusion tools to give yourself and your company something less costly than a "One Way Street."
- C. Comparison of design factors involved between designing so called economical shape extrusion dies and costly production dies such as large sheet and pipe dies.
- D. How not to be an extrusion engineer by the extrusion machine operator.

10:10 European Developments in the Extrusion Industry. E. Davey-Turner, R. H. Windsor Ltd.

Mr. Davey Turner will deliver a paper on extrusion in general and subjects relating to extrusion. Extrusion has an extremely wide field and it is therefore impossible to say that the subject of the lecture could possibly be the extrusion of thermoplastics.

Therefore, particular reference will be made to the advantage of Multiple Screw Machines and also to the extrusion of one or two of the more difficult products as well as one or two of the more eagerly awaited ones. At the moment, these would seem to fall into two categories, one being the extrusion of Flat Sheet in readiness for the expansion of the vacuum forming method which must surely come within the very early future.

Secondly, there is the increasing demand for larger sizes of Plastic Pipes in almost all materials, and some of the time will also be devoted to the most interesting subject. Finally, the paper will cover some aspects of the extrusion of certain thermoplastic materials, together with

... on Die Design and Take-Off Equipment, while ... reference will be made to advancements in the ... Multiple Screw Extrusion Machines.

... Davey-Turner, at this writing, is on a tour of ... Europe to visit the foremost Extrusion Plants ... Italy and Germany, and will undoubtedly also be ... convey to his audience the latest developments in ... countries.

11:15 **Vinyl Paste Resin Dispersions—Today and Tomorrow.** W. D. Todd, B. F. Goodrich Chemical Co.

The dispersion technique for the use of vinyl resins ... had its origin in Germany some twenty years ago ... grown to the point where an estimated 40 million pounds of resin were consumed in the United States in 1952 in this one field alone. The reason for this rapid expansion lies in the versatility of the paste technique which permits the easy preparation and the wide application of an almost limitless number of useful vinyl products. Vinyl plastisols and organosols ranging in consistency from putty-like pastes to thin fluid liquids can be molded, spread, dip-coated, printed, and sprayed and then converted into tough solids by simple heat treatment. The general principles of compounding, preparation and processing are described. The better known uses and several new fields of application are discussed.

Session B

Research Symposium

9:05 **Crazing of Polystyrene.** E. E. Ziegler, Dow Chemical Co.

10:00 **The Theory of the Changes in Physical Characteristics of Plastics Caused by Radiation.** J. W. Ryan, General Electric Co.

10:30 **Properties of Multiaxially Stretched Acrylic Plastics.** Irvin Wolock, National Bureau of Standards.

11:00 **Adiabatic Extrusion.** E. C. Bernhardt and J. M. McKelvey, E. I. DuPont de Nemours and Co., Inc.

FRIDAY, Afternoon

2:00 **The Mechanical Properties of Polyethylene.** R. H. Carey, Bakelite Division, Union Carbide and Carbon Corp.

A summary of some of the recent work on the mechanical properties of polyethylene is presented. By a combination of tensile stress-strain curves and torsional torque-deflection curves the apparent modulus of elasticity of several molecular weight grades of polyethylene have been measured over the temperature range from -125°C. to +80°C. Other mechanical properties, such as the stress and strain at the apparent "elastic limit" are also evaluated from the tensile stress-strain curves.

Between -125°C. and -30°C., torsional torque-deflection curves were obtained with the Bakelite Torsion Tester. Between -30°C. and -60°C., the torsional specimens were immersed in a coolant of alcohol, acetone and dry ice. Below -60°C., cooling was accomplished by the use of Freon 12 and liquid nitrogen. Tensile tests of injection molded specimens of polyethylene over the temperature range -60°C. to 80°C., were made in a constant temperature cabinet inserted between the cross-treads of a commercial testing machine. By means of extensometers, strains were magnified either 10 or 20 times and the load-elongation curves autographically recorded.

Tensile tests of injection molded specimens of polyethylene were also performed while the material was immersed in seven fluid environments. Failures at stresses and elongations considerably less than those normally reported were observed only when the specimens contained a small hole or a nick. The degree of the so called "premature" failure is a function of the environment and the molecular weight of the resin.

Creep curves, obtained at Bell Telephone Laboratories, on compression molded polyethylene, of a medium molecular weight grade, using stresses between 50 and 1000 psi. are discussed. The data obtained from these long time "tension" tests, most of which cover a period of one year, are compared with data obtained from short time, standard tensile tests. "Stress-Corrosion-Rupture" tests of hydrostatically inflated pipe samples, coated with a known deleterious wetting agent, Igepal CA Extra, show that there is a threshold value of stress for the occurrence of stress cracking.

2:40 **Report of the Professional Activities Committee.** L. M. Debing, Monsanto Chemical Co.

3:30 **Cutting Costs With Quality Control.** Dorian Shainin, Rath and Strong Co.

It is maintained that Quality Control can best serve the plant by reducing cost, while at the same time keeping the quality standards high, or even improving them. Costs can be cut in engineering operations, production and inspection.

The first step indentifies the relative concentration of theoretically unnecessary costs in each of these categories by appropriate subclassifications:

(1.) Rejects—imperfect bond to inserts, cracks, bubbles, blisters, die marks, foreign matter, undispersed pigment, dimensional reject, etc.

(2.) Too much or too little inspection—each characteristic related to frequency of customer complaints and assembly difficulties.

(3.) Dimensional tolerances that are too tight for economical manufacture, but which seem to be necessary to avoid assembly difficulties.

(4.) Physical, chemical, and electrical property specifications that are tighter than the manufacturing process can meet.

By using a scale of dollars, the potential savings attainable by correcting relatively few subcategories determine the program to be followed.

In the second step statistical tools for correcting such situations are described. Simple examples are given for: (a) knowing when a production process should be left alone and when it should be stopped for an adjustment to molding time, temperatures, pressures, raw material characteristics, etc.; (b) the design of a simple series of economical experiments to find the effects of certain factors while holding other factors in a balanced or neutralized condition; (c) the Multi-Vari Chart for clues to reduce the total variability of molding processes and; (d) appropriate statistical sampling plans for economically discovering lots that are more defective than desired.

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

"It is the freedom to disagree, to quarrel with authority, in intellectual matters to think otherwise, that has made this nation what it is today." Dr. James B. Conant

Preplasticizers

In the July, 1953 issue of Canadian Plastics beginning on Page 79, there is an article by Powell of HPM on preplasticizing units. The article should be read by every injection molder because it covers the HPM approach to preplasticizing very thoroughly indeed. As a matter of fact, if the SPE Journal or Modern Plastics would publish such a thorough and well illustrated article as this one, it would be a credit to them. To date, no article has appeared which so thoroughly explores and illustrates the various aspects of preplasticizing. Like any other article, however, that is written by someone who has something to sell, Mr. Powell's article completely neglects other types of preplasticizers. The Watson-Stillman type of preplasticizer is doing a fine job and some of the new IMPCO preplasticizers are beginning to get into production. I mention these because of the fact that the article in Canadian Plastics would lead one to believe that the Crown-HPM type of preplasticizing[1] is the only type available on the market. Actually, I believe there are many limitations to the HPM type of preplasticizing because of the number of shut off valves involved in the unit and for other reasons which I will not go into until I cover the whole field of preplasticizing attachments which I intend to do in a forthcoming Injection MOLDERSCOPE. To date there has been no review of the entire field and of the three basic types of preplasticizing units so far offered on the market. It would be a good preparation for a study of preplasticizing to read the article in Canadian Plastics and to familiarize yourself with the HPM method.

One of the big things in the preplasticizing field that requires a lot of study is the ability of plastic to re-heat itself on surfaces exposed to cold metal or to the air. In the glass industry, when a bottle is being made, it has such high specific heat that the surfaces that momentarily come in contact with the mold can be re-heated by merely allowing the glass parison to stand a second or two. In thermoplastics, I doubt very much if this can be accomplished, that is, if the plastic will re-heat itself and if you can ever get a mark out of the plastic or a strain out of the plastic that is incorporated in it when it contacts a cold metal surface or when it is extruded into an open storage chamber.

To date, the big trouble with preplasticizing units of all types is that they are always breaking down and something is happening to some part or other of the system. It is a rare thing, indeed, to see preplasticizers working around the clock and with the numerous advantages claimed for them. In addition, there are many types of moldings that cannot be made or should not be made with preplasticizing units. Preplasticizing units have a definite place in the injection field, but in general, they are most suitable for larger shops on larger machines. Where you cannot beat a preplasticizing unit on a machine up to and including a 24 oz., I believe it is because the heating cylinder is not properly designed. After all these years, we are just beginning to understand how to design a heating cylinder and the present cylinders have received a lot of vituperation because of the fact they were not properly designed and people have looked to preplasticizing for a miracle that can just as well be accomplished with a standard properly designed heating cylinder on machines up to and including 24 ozs. I realize I am sticking my neck out with a statement of this kind, but after all, if I did not do this, those readers of this column who love to chop at me would not have a chance to do it and that is what keeps the spark of inquiry and progress alive.

At any rate, for a very good review of the HPM type of preplasticizer every forward looking injection molder should read the excellent article in Canadian Plastics for July, 1953.

Union Demands

At this writing, another company is being added to the list of injection molders who are being forced out of business by unreasonable demands of a Union. The demands of the Union are unreasonable in the light of labor rates in other injection molding plants with which this particular company is forced to compete. It obviously would be impossible for this company to pay labor rates which are out of keeping with the rest of the injection molding industry and still remain competitive in its prices. We saw what happened at the Continental Can plastic division in Cambridge, Ohio where the Union took an unreasonable stand, and we saw again what happened at the Standard Products Co. plastic molding division in St. Clair, Mich. where the Union insisted that wage payments be scaled to those of the automotive industry instead of those of the plastic molding industry. I still have not gotten over the melancholy job of last Spring in which we liquidated the Standard Plastic Division. In the present case it shows that the Union is not respecter of the size of the company as this is a small concern with only three machines. At any rate, it is a shame when the local labor people lose their perspective and fail to realize that a given plant in a given industry must compete with others all over the country or go out of business.

HATS OFF TO MONSANTO!

The Monsanto Chemical Company through their plastics division, publishes a wonderful little paper called the "Plastics Packager." This can be obtained by writing to the Plastics Division in Springfield, Mass. Every injection molder should not only get this release but should read it and make a permanent file of it as the paper is punched on the edge for filing in a ring binder. The field of plastic packaging is the logical extension of the injection industry. We can mold thin sections and we can produce tough, lustrous boxes. New high speed molding machines for this purpose are in the offing. Machines that will shoot three and four and five shots a minute and produce packages at a cost we scarcely dreamed possible. I still feel that considerable threat to our supremacy in this field exists in the vacuum forming of these same containers. I believe that you can successfully form very substantial boxes from various types of plastic sheet. Possibly these boxes could be sold cheaper than injection molded boxes, but there are advantages that injection molding has that can always keep a certain percentage of the market for our industry. We can get lettering, designs and embossing and produce considerably more containers from a given mold than you can by vacuum forming. It is true that vacuum forming has definite advantages on short run applications and

(Please turn to page 35)

[1]Pat. Nos. 2,642,623 and 2,501,595.

PLASTICS AROUND THE WORLD

AUSTRALIA

AUSTRALIAN PLASTICS

Vol. 8, No. 97, August 1953

Abstracter: Albert Lightbody

GLASS FIBRE REINFORCEMENTS FOR PLASTIC LAMINATES. (p 6-10) by A. M. Dobson

This paper, presented at the Glass Fibre Reinforced Convention, Ashorne Hill, Leamington Spa, England, May 1952, gives a description of the forms and uses of Fibreglass in plastics in England. While the various weights, weaves, mats and rovings are available, all surface finish treated fibres have been imported. English sources of treated fibres are still being sought.

LARGE MOLDINGS ARE HIGHLIGHT OF BRITISH PLASTICS EXHIBITION (p 11)

A glider wing, 30 ft. long and 150 lbs. in weight, incorporating a furane impregnated honeycomb core, molded from phenolic impregnated asbestos was displayed. A 14 ft. diameter radar reflector, weighing 345 lbs. was similarly made. A glass-reinforced polyester water tank was demonstrated which was capable of holding 2000 gallons of water. A large car body, weighing 100 lbs. was also shown.

PLASTICS IN MODERN PRODUCTION (p 23)

Polyvinyl Cold Emulsion Synthetic Glue is now being used in England in place of animal and vegetable glues. Tremendous advantages in flexibility and permanence are claimed.

TIN STABILIZERS IN P.V.C. (p 25-32) By W. S. Penn

The advantages of the organo-tin stabilizers in polyvinyl chloride compositions are listed as clarity, lack of toxicity, suitability for high temperature work and color retention. The stabilizers are listed as dibutyl tin dilaurate, barium-cadmium-organo tin mercaptide compounds, dienophilic organo tin compounds and dibutyl tin

FRANCE

INDUSTRIE DES PLASTIQUES MODERNES

Vol. 5, No. 8, Sept.-Oct. 1953

Abstracter: Hans Mayer

STORAGE UNDER VINYLITE SHEETING

Feedstuff and other agricultural products are stored for the winter season in shallow trenches which are covered by vinyl sheeting. The sheets are placed on top of the material to be stored and the ends of the sheeting are covered with earth. If more than one sheet is required to cover the trench, any number of sheets can be placed end over end, the seams being covered with an adhesive vinyl tape. As the stored material is needed, the sheeting is rolled back as far as required and the trench covered afterwards again. The sheeting will resist cold down to -45 C. without cracking.

THE REBUILDING OF WOODEN BOAT HULLS

A method of repairing and covering wooden boat hulls by the application of glass mat and polyester is described.

PLASTICS IN SELF PROPELLED PROJECTILES — P. M. Terlizzi and A. E. Lenehan.

This type of projectile is usually powered by some liquid fuel. A gas filled polyethylene bag is stored in the metal fuel tank. As the fuel is being released for consumption, the gases expand the bag and drive the remaining fuel out of the tank under pressure. The problem of finding the proper material to keep gas and liquid separated in storage and under conditions of highly elevated temperatures as well as the test methods developed for the application are discussed.

THE PREPARATION, POLYMERIZATION AND COPOLYMERIZATION OF VINYL RESIN — G. Brus, Le-Van-Thoi, S. Fargeaudoux.

The nature, polymerization, etc. of vinyl resins are described.

CONTROL OF THE CURE OF PHENOLIC MATERIALS BY MOLECULAR STRUCTURES — H. L. Bender

Experimentation and development in this field are discussed.

GERMANY

KUNSTOFFE

Vol. 43, No. 10, October 1953

Abstracter: Anne Schwend

BASCODUR — A NEW MATERIAL FOR THE CHEMICAL INDUSTRY —Dr. Werner Kunzer and Dr. Karl Vogel, Ludwigshafen

A new curable condensation product of modified phenolics with a high percentage of fillers such as graphite, coke, coal or others, corrosion resistant against most inorganic and organic acids even in the presence of solvents at temperatures as high as 320°F; proper choice of resin may make the material also alkali - resistant within reasonable limits. A list of material resistances is added.

Compression molding of Bascodur allows specific pressures of 2133 to 2844 psi at temperatures of 320 to 338°F. for chemical apparatus and semi-finished products. Absolutely gas- and liquid-proof tubes and special profiles are extruded from Bascodur. Cements the properties of which resemble those of Bascodur permit joining of building elements which reach a tensile strength of up to 1422 psi. and chemical resistance equalling that of Bascodur. The coefficient of thermal expansion is within the same range as that of iron and steel which makes the material well suited as lining for containers of chemical substances.

A great number of items produced

from this material are discussed.

SUITABILITY OF MELAMINES FOR TABLEWARE—W. Zebrowski

A resume of properties and processing possibilities for melamine resins for tableware items.

VINYL CARBAZOLE AND POLYVINYL CARBAZOLE—Dr. Ing. H. R. Jacobi

After destruction of the production halls for polyvinyl carbazole during the war extensive research work has been done at the Badische Anilin-und Sodafabrik at Ludwigshafen, which resulted in a better polymerization process guaranteeing a polymer of higher heat resistance. This polyvinyl carbazole product is known under the trade-name "Luvican M 170".

A detailed description of the properties of monovinyl carbazole is followed by processing methods and applicability, especially for capacitor dielectrics, the impregnation and polymerization of which are described in detail.

The same details are given for polyvinyl carbazole the refractive index of which is exceptionally high when compared with other glasslike polymerizates. High dimensional stability at elevated temperatures, high impact strength, excellent insulating properties and great chemical resistance make it a very valuable plastic product which can be machined from blocks or plates, cast, compression or injection molded or extruded. Injection molding requires higher molding temperatures than other plastic materials, longer cycles, higher molding pressures and in any case preheating of the mold. Injection molded polyvinyl carbazole parts should be dumped into wood flour or another poor heat conducting material after molding to avoid quick chilling and thus cracks.

ETHOXYLIN RESINS IN HIGH VOLTAGE ENGINEERING — Dr. Konrad Meyerhans

The author tries to prove that organic resins such as ethoxylin resin, in certain instances, are capable of replacing porcelain and other ceramic insulating materials or even exceed the properties of porcelain. A juxtaposition of the properties of both materials during processing and in burnt or cured status is followed by a report on the solution of existing or new problems by using casting resins. The many favorable qualities will still not make it possible to supplant porcelain by ethoxylin resins. The high price will limit their use to those cases where the properties of the resin will improve the quality of the apparatus in question considerably.

SYNTHETIC RESIN PLATES — UTILIZATION AND FABRICATION — Dr. V. Hartmann

A survey on present-day aspects of the synthetic resin plate industry, particularly the forms of application and proper fabrication methods.

IMPACT - RESISTANT POLYSTYRENE — Hans Mair, Ludwigshafen

The Badische Anilin-und Sodafabriken have developed two new kinds of polystyrene:

(A) **Polystyrene EF.** A pure polymerizer of high molecular weight and improved mechanical properties, impact strength 35 cmkg sq.cm., good dimensional stability under heat and high wear resistance. Flowability of this material is, however, low due to the high molecular weight and hence processing is rendered more difficult.

(B) **Polystyrene EB.** A co-polymer, modified with butadiene, of high impact strength (75 to 80 cmkg sq.cm.), relatively high dielectric loss factor.

Water absorption of these two materials is considerably higher than that of plain polystyrene. Butadiene-modified polystyrene tends to ageing, however. Research work under way is aimed at elimination of ageing and improvement of weather resistance.

Polystyrene EB can be either injection molded or extruded. Injection molding requires high molding temperatures (between 392 and 464° F.) and pressures (minimum 14223 psi). It is recommended to work with molds preheated to 140 to 158° F. to guarantee a high gloss of the surfaces. Injection molded parts may be buffed easily. Shrinkage of high polystyrene varies between 0.7 to 1% depending on the shape of the molded part and observation of molding requirements. Polystyrene EB closes the gap so far existant between rigid polystyrenes and the tough, elastic and wear-resistant polyamides.

THE CONTINUITY PRINCIPLE APPLIED TO SURFACE FINISHING OF PLASTIC SHEETING — Dr. P. Dornbusch, Krefeld

European market conditions, often asking for small lots of plastic sheeting either as to color, pattern or shade, etc., are slowing down rationalization trends and attempts to reduce the wage expenses in surface finishing of plastic sheeting. Three different ways of the applied continuity principle are discussed:

Continuous single operations working with two take-up rolls so that when a certain length of sheeting has been taken up, the material is automatically cut and rolled on the second roll. The full roll will then supply the sheeting to the next finish operation. The end of one roll and beginning of the next may be bound together while the machines are running.

The second applied continuity principle consists in a combination of simultaneous stamping and shading by turns or stamping and printing or printing and stamping by turns.

The maximum of rationalization would be a combination of production of sheeting and finishing operations which, however, meets with considerable difficulties due to different temperatures required for individual processes and the different output of sheeting and stamping calenders and printing, dyeing and shading machines. Synchronization of all of these operations would mean ineffective utilization of part of the machinery.

1044 AUTOPLAS SINGLE STAGE MULTI-SCREW PRE-PLASTICIZER UNIT

A full description and technical data of this new R. H. Windsor pre-plasticizer — injection molding machine.

MOLD LOCKING FORCES FOR INJECTION MOLDING MACHINES LOCKING MECHANICALLY —Obering. Hans Beck, Ludwigshafen

The effective powers developed in mold cavities during injection molding, which are rapidly increasing and decreasing, so far cannot be defined accurately. Since these forces play a decisive role in the calculation of mold locking devices required in order to obtain moldings without flash and of accurate dimensional stability, a group of engineers have undertaken to investigate and measure the temperatures developed during injection molding, the forces and deformation created, power input and consumption, and in this connection the mold locking forces of mechanically operated locking devices (toggle lever system), dependent on an angle "a" between tie bars and toggle levers, are calculated for both the case of elastic deformation of tie bars, toggle levers and mold only and that of elastic deformation including platens and bolts in the toggle lever. Good consonance of actually measured results with these calculations is reported. The driving force required for working the toggle levers, also dependent on the angle "a", is also calculated when considering or disregarding the friction involved.

POLARIZATION OPTICS FOR INVESTIGATION OF PLASTIC PARTS — Dr. Siegmund Wintergerst

Polarization optics do not only give the research man a tool for looking at the interior of macromolecular transparent plastics and drawing conclusions as to the construction of materials, but it is a big help for any molder in the surveillance of production. This article therefore deals with the main causes and effects of forces responsible for anisotropy of plastic parts, molecular orientation and the results and conclusions elucidated by optical polarization.

FABRICATION OF LAMINATES — H. Zickel, Troisdorf

Advice as to proper use of tools

technicalia to be observed when ... laminated paper, textiles ... is given.

DESIGN OF INJECTION MOLDS (EJECTION OF PARTS) — H. Gastrow, Berlin.

Automatic injection molds demand special consideration be given to ... of the molded part, polishing ... mold and ejection of flat, deep, ... and tubular parts. Hence, design details for such molds are discussed.

POTTING OF METAL PARTS IN UNSATURATED POLYESTER RESINS — Dr. Alfred Muller, Ludwigshafen

The possibility of obtaining absolutely bubble - free polymer of polyester resins, the relatively little time required for curing, minimization of imbedded stresses, excellent transparency, shrinkage of material during polymerization and good machinability make unsaturated polyester resins a desirable material for the preservation of metal parts. Details of potting process are discussed.

THE SOLUBILITY OF HIGH POLYMERS — Dr. O. Fuchs, Frankfurt Main.

Data on the interaction of high polymers and solvents shows little systematic order so far. To help in finding other solvents for already known high polymers and new solvents for new high polymers, the author demonstrates with the help of many examples that there is a way for qualitative interpretation of the solubility of high polymers on the basis of intermolecular forces known already, such as dispersion and induction forces, dipoles and hydrogen links. The same interpretation will answer for the fact that two non-solvents will frequently act as solvent in the reverse case when two solvents will act as non-solvents with one polymer. There cannot be said anything about quantities so far since thermodynamic data has to be completed first. Farbwerke Hoechst are working on this problem.

TEMPERATURE CONTROL OF CALENDER ROLLS — Georges Ardichvili, Antwerp

Description of a small supplementary apparatus for the heating of calender rolls by induction. Distribution of heat zones on the rolls is left to the discretion of the operator and the apparatus shall increase, even overheat certain zones of the roll surfaces.

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DER PLASTVERARBEITER

Vol. 4, No. 9, September 1953

Abstracter: Ernest C. Bernhardt

NEW LINE OF EQUIPMENT FOR ELECTROSTATIC FLOCKING PROCESSES. By F. Hesse. (Page 252)

A complete line of new equipment for the continuous application of flock to a variety of products is described. (Eloflock Co.)

WELDING PVC TO SHEET METAL. By J. Brandenburger. (Page 258)

A process for welding PVC by high frequency to lacquered sheet metal is described.

CONNECTIONS FOR PVC PIPE. (Page 272)

A very gently undulating thread is formed on PVC pipe by a blow-molding process. It is claimed that this constitutes a very cheap way of forming a connector which is integral with the pipe, and avoids bulky flanges.

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GREAT BRITAIN

BRITISH PLASTICS

Vol. 26, No. 293, October 1953

Abstracter: F. A. J. Mol

PROSPECTS FOR MELAMINE TABLEWARE—Anon. pp. 352-356

American experience and practice with melamine tableware are contrasted with and used as an example for British experience and development.

The advantages of melamine tableware (less breakable, lighter weight) are substantiated with figures. Design considerations are given some attention, a drawing of the hypothetical ideal melamine cup is given. The most difficult part is always the design of the handle.

Very little difference exists between the molding techniques of American and British molders of melamine. The powder is preformed into 'pills' which are preheated before molding to about 280 degrees F. This preheating results in shorter molding cycles, lower molding pressures and better uniformity. Molding pressures are about 3000 psi, molding temperatures average 330 degrees F.

BLOW MOLDING OF POLYTHENE BOTTLES—Anon. pp. 357-360

As blow molding of polyethylene bottles has by now become a common practice in the United States, it is interesting to see that this technique is now being used successfully by several firms in Britain. The process as developed there is a combination of injection molding and glass blowing procedures. The parison is injection molded around a blowing tube and is, with this tube still inside, transferred to a mold corresponding in shape with the bottle to be molded. Air is blown into the parison through the tube so that the polyethylene is forced out against the walls of the mold. Molding cycle: about 30 sec. for the blowing, 15 sec. for the injection molding of the parison, 5 sec. for the transferring operation. Very clear diagrams are given showing the main features of the blowing head assembly in detail.

STEAM RECIRCULATION — Leo Walter

The object of steam circulation, very useful for steam heated dryers, platen presses etc., is to give the maximum possible velocity through the steam space. An increased steam velocity may improve the heat transfer from steam to platens.

The basic elements of the operation of recirculation are discussed. Examples of improved performance are given. For a multiplaten press, the heating up time was reduced from 45 to 25 minutes, temperature differences between top and bottom platens were brought back from 10 to 5 degrees C. Attention is paid to the cases of series and parallel steam connections in multiplaten presses. The limitations of the method are discussed. In general the method is most effective when the heating channels are relatively narrow and are comparable with the cross sectional area of the steam inlet. Much of the useful effect is lost when the steam space is of much larger area than the inlet, for example in an drying cylinder.

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PLASTICS

September 1953

Abstracter: A. T. Rexer

P.V.C. PASTES. By A. E. Lever

A four page article with illustrations and tables covers the forming of plastics products from dispersions of polyvinyl chloride. The author discusses the constituent materials of plastisols, organosols, and plastigels and reviews the published literature and patents. Molded and expanded products also are covered.

PLASTICS IN THE SERVICE OF MAN

Four pages of illustrations give a pictorial review of high-quality units used in the field of advertising.

THE USE AND POTENTIALTIES OF SPRAYING VINYLS. By J. B Singer

A two page article with illustrations describes the present uses and suggests various applications of the technique of spraying synthetic res-

(Please turn to page 32)

SECTION NEWS

Edited by

Stanley Bindman

Jamison Plastic Corp.
71 E. Sunrise Highway
Freeport, New York

Decorative Treatments for Polystyrene Illustrated at New York-Newark Meeting

Arthur M. Merrill

The New York Section was host to the Newark Section at a joint dinner meeting, the first of this season, on November 18 at the Gotham Hotel. Approximately 135 members and guests attended the meeting which included a cocktail hour, dinner, brief business meeting, and a technical session. Speaker of the evening was Ralph E. Hammer, Monsanto Chemical Co., who discussed "Decorative Treatments for Polystyrene." Mr. Ralph F. Hansen, of Monsanto, had originally been scheduled to talk on marketing of plastics, but was unable to attend because of business committments. Following the talk was a showing of the Tennessee Eastman Co. sound-color film on the use of Tenite plastics in Australia, particularly in water pipe.

Mr. Hammer gave an interesting discussion of decorating techniques and applications, using many slides to illustrate his talk. Among the topics covered were lacquering, including design requirements, surface preparation, lacquer requirements, and advantages, metallization of plastics by means of electroplating, spraying, vacuum metallizing, and cathode sputtering; printing and stamping methods, including silk screening, hot stamping, dome and offset printing, rubber stamping, and decalcomanias; and destaticization treatments.

New York Section president Saul Blitz, Tico Plastics, Inc., presided over the meeting and introduced the Newark Section officers present. An invitation was extended by the Newark Section to attend a joint dinner meeting on January 13, 1954 at Newark. The speaker was introduced by the new program chairman, Harriman H. Dash, Arma Corp.

Table favors were distributed through the courtesy of Empire Brushes, Inc.; Ferro Chemical Corp.; Monsanto; and Naugatuck Chemical Division, United States Rubber Co., and the meeting included a drawing for door prizes contributed by American Molding Powder & Chemical Corp.; Dusal Tool & Mold Co.; H. Kohnstamm & Co., Inc.; Naugatuck; and Robinson Plastics Corp. Door prize winners were C. F. Hutcheon, World Plastex; Frank Quinby, Celanese Corp. of America; Herb Reeves, American Hard Rubber Co.; Sam Silberkraus, Riverdale Plastics Development Corp.; and your reporter. The prize drawing was conducted by Carl Virgin, Naugatuck Chemical and chairman of the favors and prizes committee.

The next meeting of the New York Section was the annual Christmas party on December 16 at the Gotham Hotel. Anyone who attended or is acquainted with the previous parties needed no further notice.

New members added by the New York Section during the past month were: Herman G. Baur, sales manager, Ball & Jewel, Inc.; Elliott N. Dorman, technical representative, Ciba Co., Inc.; Henry G. Jacobs, president, H. G. Jacobs Mfg. Co., Inc.; Peter Lachina, department chief, Machine & Metal Trades Technical & Vocational High School, New York City; Joseph Powazi, foreman, Modern Tool & Die Co.; Abraham, Henry G., and Ross Rosenberg, all of Rosenberg Brothers & Co.; and Samuel Zimmerman, president, Merit Creations, Inc.

High Impact Styrene Is Southern California Meeting Topic

Austin H. Herbst

Mr. R. D. Sackett of the Plastics Division of Monsanto Chemical Company, Springfield, Mass., one of two speakers at our November meeting, spoke on the subject, "High Impact Styrene and How It Fits Into Today's Market." The comparative properties were listed of the various grades of impact styrene presently available. Colored slides were shown illustrating some of the interesting applications for these materials. The highlights of high impact styrene and its relationship to the vacuum forming field were covered.

Mr. Jack S. Aubrey was the second speaker and represented the Western Division of Monsanto Chemical Company, and spoke on the subject, "How Vinyl Can Fit Into Your Injection Molding Picture." A basic summary of what makes up a vinyl molding compound and the difference between granulated and dry blend materials was given. The proper and the wrong way to mold vinyl included the showing of various devices to aid in molding.

A cocktail hour and steak dinner preceded the technical meeting with 125 members and guests present.

The following new members have joined the Southern California Chapter during the past six months. Mr. Robert Milby, Edmond Kelly, Dr. R. L. McCurdy, Jack Aubrey, Eugene Van Winkle, Ray Cutler, Joseph Pillipson, W. W. Pearce, Carlie Hussey, E. A. Lasher and Al Abshire.

The following S.P.E. members have joined us by transfer: Mr. John Lee (Philadelphia), Mr. Richard Hogg (San Francisco), S. Berger, (Rhode Island), David Rome (New York), J. W. Richardson (St. Louis), and W. E. Wright (Pennsylvania).

Miami Valley Section Elects New Directors

John L. Russell

President Joe Merke has announced the election of three new Directors to serve on the Board for the next three years. They are Jacques Barnhisel, National Cash Register Co., Dayton; Lloyd Larrick, Recto Molded Products, Inc., Cincinnati; and Joseph Overwein, Inland Div., General Motors Corp., Dayton.

Those whom they succeed are Ralph Backscheider, Recto Molded Products, Inc., Cincinnati; Carl Weber, Crosley Div., Avco Corp., Cincinnati; and Otto Fiedler, F. & F. Mold & Die Co., Dayton. These men deserve many thanks for their untiring efforts in behalf of SPE during the past three years. The new Board of Directors has met and announced the selection of the following officers for 1954: President, Frank Strobino, General Electric Co., Dayton; Vice-Pres., Carl Ackerman, Crosley Div., Avco Corp., Cincinnati; Robert A. Wright, Dimon-Gray Co., Dayton; and Richard Bly, Formica Insulation Co., Cincinnati. Congratulations, men!

South Texas Panel of Experts

The panel of "experts" who told the story of new development in reinforced plastics to the South Texas Section in November: front row left to right, John Girner—American Cyanamid Co., Chas. Frantz—Plastics Mfg. Co., F. L. Murdock—Murdock Tank Co., George Smead—Libby-Owens-Ford Glass Co., K. W. McLoad— Ratio Manufacturing Co. In the back row: Jim Pinkston and Ray W. Meyer, President and Program Chairman of the South Texas Section.

Significant Developments in Reinforced Plastics Interest South Texas Section

W. E. Wiese

"Significant Developments In Reinforced Plastics" was the subject discussed by a panel of five experts at the meeting of the South Texas section in November. This was our second reinforced plastics forum in two years, and we hope to make this an annual affair.

Mr. F. L. Murdock of the Murdock Tank Company—Tulsa described the evolution of their corrosion resistant glass reinforced plastic tank for oil field service. Development of this tank began several years ago with the help of the glass fiber and polyester resin suppliers. The design was based on Army-Navy specifications which had severe strength requirements and specified a bolted, lapped joint. The first tank was relatively small, 250 barrels capacity, vertical and cylindrical, 8 feet diameter by 8 feet high. After a period of testing, both for practicability in oil field service as well as for mechanical strength, Murdock now can supply tanks of 750 barrel capacity with a height of 24 feet. A unique improvement in the bolted, lapped joint permits Murdock to claim a 16 to 1 safety factor in the tank design.

They now have Murdock tank installations in all parts of the world where they have demonstrated their practicability, particularly where corrosion is a factor. In some instances steel tanks corroded through in less than eighteen months whereas the Murdock reinforced plastic tank apparently will last indefinitely.

Mr. George Smead of the Libbey-Owens-Ford Glass Company—Toledo described the development of the Chevrolet Corvette, reinforced plastic body. The first Corvette was exhibited at the General Motors Motor-rama at the Waldorf Astoria in June, 1952, and the public responded favorably to this introduction to reinforced plastic automobile bodies. The Molded Fiberglass Company, who specialize in matched-metal molding techniques, have contracted to produce 300 Corvettes for General Motors in 1953, and 10,000 in 1954. In order to speed-up initial production, some of this work has been subcontracted to Lunn Laminates, who are experts in the bag molding field.

Sculptors, engineers and designers from the automotive industry, glass and resin suppliers and several major chemical companies cooperated with the molders in developing the Corvette bodies. The finished product weighs 200 pounds less than the same body in metal. Plastic bodies are more expensive than the same body of steel, but with greater production volume next year, this situation may change. Meanwhile, 200 of these bodies have been produced, and there is a long list of potential purchasers for future production.

In contrast to the work done by General Motors, Mr. K. W. McLoad of the Ratio Manufacturing Company—Houston described the efforts of a much smaller organization to develop a glass reinforced sports car body. They found that their biggest initial problem was the creation of a design which would meet with public acceptance. The mere mechanics of automobile design is difficult since a mass of compound curves are involved, with no straight lines to use as reference points. The Ratio Manufacturing Company learned early that a small scale model was required, and that it was easier to transpose the design from a scale model to full size. Up to now, they have made just a few bodies, to fit the Ford frame, but their development work is now complete, and they are prepared to produce bodies commercially. They are aiming at the typical sports car hobbyist who spends many hours working on the mechanical aspects of his custom-built automobile but does not have the talent nor facilities to make a handsome body. The Ratio Manufacturing Company will supply this need.

Mr. Charles Frantz of the Plastics Manufacturing Company—Dallas described the evolution of their glass reinforced plastic cafeteria tray. They learned early that the design of glass reinforced plastic moldings should be based on the physical properties of the raw material. Their first tray was made to look like existing cafeteria trays made from other materials, but this was unsatisfactory. Through proper design, superior strength and ap-

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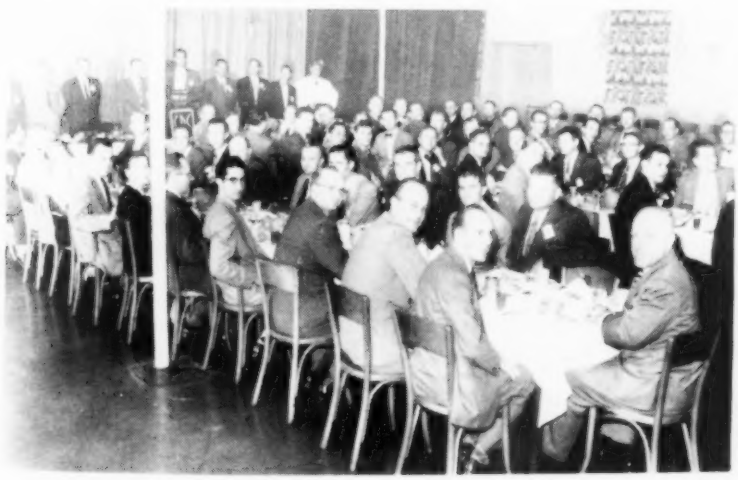

About eighty members and guests of the South Texas Section of the Society of Plastics Engineers, attended the dinner meeting and technical session at the Alabama Banquet Hall—Houston, Texas in November.

South Texas

(Continued from page 29)

pearance characteristics were obtained.

A problem which is unique in the production of a cafeteria tray is the resin-glass bond for maximum water resistance. This was accomplished through proper use of sizing agents for the glass. The Plastics Manufacturing Company trays have no fillers, since these would reduce their water resistance.

Two properties of polyester resins which are of interest and importance to all molders are light stability and fire resistance. Mr. John Girner of the American Cyanamid Company described two resins which were developed by his company during the past year.

They reflect outstanding improvements in both of these properties as indicated by comparative tests conducted during the past year. No noticeable change in color resulted from accelerated aging tests or tests conducted in direct sunlight. Mr. Girner demonstrated the superior fire resistance of these new resins by igniting two pieces of reinforced plastic; the one made from Cyanamid's new resins was self extinguishing while the piece made from the old type resin continued to burn after it first was ignited.

Prior to the panel discussion, Mr. Ed Pennell of the Owens-Corning Fiberglas Company added a light touch when he appeared dressed in a Swami costume, red turban and all, and with the aid of a Fiberglas "crystal ball" looked into the future and predicted continued new applications for glass reinforced plastics.

Our meeting was held in the Orchid Room of the Alabama Banquet Building with President James Pinkston, presiding. The panel of speakers were introduced by Mr. Ray Meyer, our Program Chairman.

October Meeting

The South Texas Section was fortunate in having Mr. Harold A. Holz of the Bakelite Company as speaker at our meeting of October 21, 1953.

Mr. Holz is the technical representative of the Molding & Extrusion Materials Division of the Bakelite Company, and he is well qualified to speak on his subject: "POLYETHYLENE."

Polyethylene is one of the most dynamic molding materials available today. Its properties and characteristics first rose to prominence with the U. S. Navy early in the last war. Since then there has been a continuing race between supply and demand for both civilian and military purposes. Actually, the military interest has been the most significant spur to the development of processes for making high purity polyethylene, and industry in general has benefited.

Polyethylene became important with the beginning of production in Bakelite's wartime plant in South Charleston, West Virginia, in April, 1943. The pressures involved in the production of this material are the highest achieved by any continuous commercial process in the world today. The pressures are equal to those exerted by explosive gases in the barrel of a standard five inch Navy antiaircraft gun. Pressures in the gun barrel last only a fraction of a second, but the same pressure is battering continuously day in and day out at the equipment used for producing polyethylene.

Everything that can be said about polyethylene is good. It combines the electrical properties of low loss, excellent power factor, high dielectric strength, and high resistivity, with the added properties of flexibility at sub-zero temperatures, light weight, and great resistance to wear and abrasion. It is colorless, odorless, tasteless, has exceptional resistance to acids and alkalies, and in general has a high degree of chemical inertness.

Its moisture vapor transmission is so low that it is difficult to measure. It has permeability for oxygen and carbon dioxide.

From the viewpoint of the molder, it can be fabricated with ease by the usual molding techniques, into bottles, housewares, and a long list of industrial applications. Monofilaments are important as seat covers, and flexible tubing and piping are finding increasing applications in irrigation and well systems.

Peace time counterparts of radar, television lead-in wires and coaxial cables are but a few products which capitalize on its electrical properties. Extruded films of polyethylene only a few thousandths of an inch thick have come into extensive usage, especially in food packaging where moisture retention for freshness is desirable. Almost all of the Texas 1952 carrot crop, for example, was packaged in polyethylene film.

Chemical inertness and flexibility resulted in the present popularity of the familiar polyethylene "squeeze bottles." Unbreakable chemical containers are available in sizes from a few ounces to 13 gallons. These two products are made with ease and rapidity by the blow-molding technique.

Industrially, polyethylene has a brilliant future. The available supply has been behind the demand despite a twelve fold increase in production capacity during the ten short years of its life. During the same period the price has been cut in half. Bakelite is continually expanding their facilities, and duPont has become an important supplier. It is expected that four or five other manufacturers will enter the field by 1955.

Mr. Holz's talk was very well received by about fifty members and guests of the local section. As usual, the meeting was held at the Frontier Inn with President, Mr. James Pinkston, officiating.

Chicago Meeting Topic Is Injection Molding of Vinyl Dry Blends

M. A. Self

Approximately 80 members and guests attended the November 18 meeting of the SPE-SPI in Chicago. The speaker of the evening was Mr. R. F. Hill who is in the Technical Service of the Vinyl Resin Department of Monsanto Chemical Company in Springfield, Massachusetts. The subject covered by Mr. Hill was "Injection Molding Vinyl Dry Blend Materials." These materials are finding wide application where a tough abrasive resistant and high gloss material with good flexibility is desired. In many applications it is employed by molders normally molding rubber materials because of the high gloss and abrasion resistant properties while at the same time allowing the employment of under cuts such as commonly used in the rubber industry. Numerous specific applications for the product were described and displayed ranging from fly swatters to luggage handles and corner strips for luggage. Much interest was aroused as a result of Mr. Hill's discussion as was evidenced by the lively question and answer period following Mr. Hill's talk.

The Chicago section was also honored with the presence of the national secretary Mr. P. J. Underwood. Mr. Underwood spent November 18 and 19 in the city of Chicago visiting numerous companies in the area. In Mr. Underwood's comments before the meeting he outlined the new program of the National to establish a technical advisory committee on various phases of plastic problems. The members of these committees will be at the disposal of anyone in the plastics industry through the National office to answer questions on their particular field. It was also emphasized that a very active membership program was underway with the goal being a 100% increase in membership in the next twelve months.

"Product of the Times"

Luminescent Plastics Corp., 161 W. Washington St., Chicago 6, Ill., present a brochure "Product of the Times" which deals with luminescent molding powders.

Cleveland-Akron Speaker Displays Molded Item

E. B. Stratton Explains Vacuum Forming Processes to Cleveland-Akron Section

Frank A. Martin

The Cleveland-Akron Section turned out 75 members and guests to hear E. B. Stratton of the Auto Vac Company describe the vacuum forming process, on November 9th at the Spanish Tavern at Brecksville. Mr. Stratton's talk and exhibit of samples was a revelation to our group of molders and extruders. Since our excellent review of a talk by one of Mr. Stratton's co-workers was fully reported in the November Newark Section news the details will not be repeated here, but it must be reported that he aroused a great deal of interest in the process.

The results of elections to the board of directors for the section were announced. Mr. H. D. Oliver of Eastman Chemical Products, Granville Shirley of Colonial Plastics, and Wayne Anderson of Anderson and Company, were elected to fill vacancies left by Hugh Winn, Barney Wulf, and Frank Martin.

The section used, for the first time, its new PA system. This system consisting of a fine 18 watt amplifier, 2 mikes, and 2 speakers, all portable, was purchased so that regardless of where meetings are held we will always have adequate facilities for the speakers.

The Annual Christmas Party for the ladies was held at the Auora Inn on December 11th, with our new executive secretary, Mr. Underwood, as a guest. Ward T. VanOrman was in charge of arrangements.

Second Look at Plastics in Europe Provided Baltimore-Washington by Kline

Irvin Wolock

The second meeting of the fall season was held at the Emerson Hotel in Baltimore on Tuesday, October 13 with over fifty people in attendance. The guest speaker was Dr. Gordon M. Kline of the National Bureau of Standards and Technical Editor of Modern Plastics. His topic was "A Second Look at Plastics in Europe." Dr. Kline discussed the recent meeting in Stockholm of Technical Committee 61 on Plastics of the International Standards Organization. The establishment of international standards on plastics is of great interest to the United States since this country exports more plastics than any other country. Speaking about the plastics industry in Europe, Dr. Kline pointed out that most countries are still endeavoring to catch up with the progress made in the plastics industry in this country. One case in which a European country is ahead of this country is in the development and production of the cross-linked polyurethanes in Germany. German plastics production is already on a par with Great Britain, and one can expect Germany to assume the leadership of the plastics industry in Europe.

An added feature of the meeting was an impressive Rohm and Haas Company exhibit of "Plexiglas Applications for Industry and the Armed Services."

Over fifty people attended the opening meeting of the season of the Baltimore-Washington Section to hear a symposium on "The Limitations of Plastics." The meeting was held on Wednesday, September 23 at the Langley Park Hot Shoppe in Washington. Mr. Frank W. Reinhart of the National Bureau of Standards was moderator of the symposium. The panelists were: Charles M. Gardner, Office of the Quartermaster General, U.S. Army; Philip M. Goodwin, Bureau of Aeronautics, U.S. Navy; H. A. Perry, Jr., Naval Ordnance Laboratory; and Lorenz E. Sieffort, Bureau of Ships, U.S. Navy.

It was recognized that the limitations of plastics are not inherent in the materials themselves but must be related to the proposed applications. Some of the factors mentioned which limit the uses of plastics for certain applications are: relatively low strengths and moduli, including a low modulus to weight ratio when compared to some metals; tendency to degrade under certain service conditions; limited heat resistance; dimensional instability as far as very close tolerances are concerned; permeability to various liquids and gases; high cost; and the uncertainty of the properties of commercial reinforced laminates. It was pointed out that reliable performance data are needed on both old and new materials.

In spite of the numerous limitations elucidated, the general feeling was summed up by one of the speakers who said that, "With proper selection of the plastic, and proper design and fabrication, there is no such thing as a bad plastic."

Frank W. Reinhart, U.S. Bureau of Standards, discusses limitations of plastics with Baltimore-Washington Section.

From left to right: H. LIANDER, Sweden; G. M. KLINE, United States; O. STUREN, Sweden.

The Technical Committee 61, Plastics, of the International Standards Organization, meeting in Stockholm.

Dr. Gordon Kline Of NBS Attends International Standards Meeting In Stockholm

The Technical Committee 61 Plastics within the International Standards Organization (ISO TC 61 Plastics) held its third meeting, since it was established in New York in 1951, in Stockholm, August 10th—14th.

Working Groups on Physical Chemical Properties, Mechanical Strength Properties, Thermal Properties, Chemical and Environmental Resistance, Laboratory Atmosphere and Conditioning Procedures, and Nomenclature and Definitions met and discussed proposed standards for use in international trade. Six draft proposals pertaining to test methods for the determination of water absorption, apparent density of molding powders (pourable and non-pourable through a funnel), acetone soluble matter in phenolic moldings, flexural strength properties, and heat distortion temperature were agreed upon for circulation to the participating member countries for their consideration. This will be handled by the American Standards Association which is the Secretariat for ISO TC 61, through correspondence with the national standardization bodies in the various countries.

Invitations have been received to hold a Meeting in 1954 in Philadelphia and in England; a decision will be made after consultation with the participating member bodies.

Quite a number of people attended the meeting, which was organized by the Plastics Department of the Swedish Standards Organization in cooperation with the Swedish Plastics Federation at Svenska Teknologföreningen (The Swedish Association of Engineers and Architects) in Stockholm.

Plastics Around the World

(Continued from page 27)

ns, particularly in the field of roof covering and other building applications.

HARDNESS TESTING OF PLASTICS. By Paul Grodzinski.

A three page article with illustrations and charts discusses the limitations of present methods and equipment used for the hardness testing of plastics. Two new instruments are described which are said to overcome some of these limitations.

IMPROVING THE QUALITY AND EFFICIENCY OF PLASTICS MOLDING. By W. M. Halliday

The third article on the above subject covers the last three recommendations made by the Productivity Team on Plastics Molding.

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Spain

REVISTA DE PLASTICOS

Vol. 4, June 1953

Abstracter: John B. Ballard

THE PLASTICS DEPARTMENT OF THE JUAN DE LA CIERVA FOUNDATION

An editorial describing the facilities and activities of this non-profit organization, which engages in research, development, testing, and information services, and edits the Plastics Review.

Will Adams Retires

The Adams Plastics Co., Inc., of Holyoke, Massachusetts, announces the retirement of Mr. Will Adams, President of the Company since its founding in 1945. Mr. Adams plans to enjoy a long earned vacation.

Attorney Samuel Resnic, Treasurer of the Company from its inception, has acquired the interest of Mr. Adams and has been elected its President to succeed Mr. Adams. Mr. George P. Alderman, Vice President and General Manager and Mr. Barton S. Resnic, a recent graduate of Harvard Law School, have been elected as Directors of the Company.

Vacuum Forming

(Continued from page 10)

of being the "handicraft" industry.

important problems which arise almost simultaneously with equipment construction concern mold materials and trimming methods. Factors which are most influential in making a decision as to what materials are to be used for mold construction and what equipment is to be utilized for trimming the finished article are quantity and quality of parts to be fabricated.

For comparatively short runs of 10 to 500 parts, molds may be constructed from wood, plaster, or plastic. The trimming of these parts may be accomplished through the use of power shears, band saws, milling machines, or hand shears.

Mold material for medium runs from 500 to 10,000 parts may be plastic, sprayed metal or low melting alloys. The trimming of parts, by necessity, should be more efficient. Punch presses and clicker presses may be used with steel rule or high dies.

Large production runs of 10,000 parts or more will demand molds constructed from more durable materials such as cast aluminum, iron, magnesium, or steel, and machined metals. For increased speed of production, this type of mold should be cored for cooling. In conjunction with this, trimming dies should be constructed of equally as durable materials.

The designations for length of runs noted above are arbitrary. Molds constructed from less costly, less durable materials become defective sooner than those from better materials. Consequently, the use life of the mold will terminate when the defects transferred to the finished article become intolerable. Therefore, the degree of perfection required in the finished part will also determine what materials may be used for construction of molds for a given length of run.

In all outward appearances, plastic sheet fabrication is on the up-swing. The development and utilization of improved, lower cost materials plus the design of more efficient equipment and techniques is opening up markets where plastics could never before compete.

NU-BONE CO. ANNOUNCES OPENING OF PLASTICS DIVISION

Since its inception about one year ago, when production was limited to Fibre Glass Reinforced Polyester Traffic Control Signs, N B C Plastics Division of the Nu-Bone Co., Inc., has expanded to include complete injection and compression molding facilities.

N B C Plastics Division, under the direction of Mr. J. P. Brecker, presently occupies about one fourth of the 75,000 square foot building owned by the NuBone Co. at 25th and Ash Sts., in Erie. Founded 45 years ago in Corry, Pa. the NuBone Co. moved to its present location in 1921 and plans to devote an increasing percentage of its production facilities to plastic molding in the future.

CD MOLD RELEASE B, originally developed for the release of polyester and epoxy resins, has been discovered to be an excellent release agent for phenolic, melamine, and similar materials. This product has proved of particular value because it is crystal clear and does not discolor on blacks, ivory, and other colors. No buffing or polishing is required. Every part has a high gloss or lustre. No oily film or burnt areas are left on the article.

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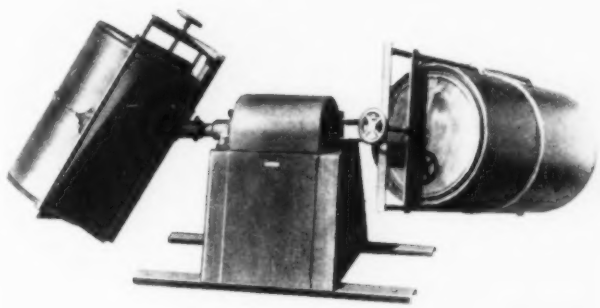

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Plastics and Designer

(Continued from page 13)

standing of no one industry, but of many. He must also possess a working knowledge of manufacturing considerations, marketing, and merchandising as well as astute esthetic judgement.

The designer of today is a specialist and more and more manufacturers are turning to him since they know we are living in an age of specialization. The profession stylists have performed and are performing, an invaluable service to industry despite a strong predilection on the part of manufacturers to shy away from new materials, new methods, and new appearances.

The success of any product is graphically measured in sales figures and if a product is selling well, then the design must be considered as good regardless of what improvements might be advantageously made in mechanics. Until the selling profits and volume begin to drop, revision by the stylist is almost always out of the question.

Even when sales begin to lag, most manufacturers are reluctant to give the designer a free rein and limit changes to a narrow field. Consequently, the designer must take in small steps what his vision tells him should be taken in a single stride. Little by little, he introduces better appearance, different materials, and improved methods until the manufacturer finally realizes that sales are a result of what the public wants and not what he thinks they want. The greatest ally in an industrial designer's work, as revealed to him through extensive research and surveys, lies in the plastics material field.

With the use of plastics, the stylist can construct good sales-winning design at a fraction of a cent more per unit. With plastics, the designer can judiciously apply eye-pleasing style and appearance which can make all the difference to the product's sales record.

Progressive thinking industrial organizations of today are coming to realize more and more that, of all the factors which make a product desirable, appearance is by far the most potent. In order to sell a product, attention must first be attracted to it and the best way to achieve this by creating a striking design.

This calls for a certain amount of dramatics, color, sparkle, and individuality. It is not a simple matter to create a design which has the necessary character and which will influence the maximum number of people to make a purchase. Striking design is about the only factor which can accomplish this.

Design helps also in the advertising of a product in addition to providing the sales people with something to talk about at the point of contact. It is invaluable here since most retail sales people are not fully trained and therefore the product must sell itself. As for the retail sales people, a well designed product can sell the sales person and even prompt them to do a better selling job.

To make certain that plastics are used, plastics material salesmen, engineers, or custom molders would do well to do a little selling of good design on their own. Good design increases volume of material and molded parts which are sold to the product manufacturers.

Take for example, a customer who has a poorly designed product. He looks to plastics to drum up sales; however, after the conversion to this material, the customer still does not sell many more of his article. Consequently, he does not buy more parts, or material. But suppose he is sold on using good design, in plastics of course, or is just sold on a designer to act as a "doctor" for his sales sick product.

The designer, by applying the principals of good appearance, can devise a better model, which is, as has been stated before, an important factor in the quest for sales-winning product. As a direct result of a well designed product, the manufacturer sells more articles, and the plastics people sell more parts.

It is wise, in most cases, to follow the pattern of having the manufacturer pay for the design, since he is more sure of getting what he wants in the way of mechanical requirements. The molding companies, who attempt to take over the design are doomed to failure because, in most instances, they are not aware if their design is mechanically adequate.

In addition, the molding companies usually cannot invest enough capital in design, and as a result, the models do not show the product off to its best advantage. It would be wiser for the molding companies to spend a half-hour selling the customer on buying good design rather than spending money on inadequate design.

All products must be designed in one fashion or another. Selecting the person or organization to do the job is not always simple. There are good designers and poor ones but one common mistake most manufacturers make is to allow an engineer to act as the stylist. The engineer's function is of the mechanical, even though it may be of a creative mechanical nature.

There are many differences between the profession of industrial design and that of engineering. The basic difference, however, is not recognized by many, including even the engineers and the designers themselves. The distinction exists in that the industrial stylist is concerned with the psychological while the engineer deals with the physical. It is of no consequence that both are working on the same tangible product.

The engineer is entrusted with the task of creating a mechanism which will perform a given duty and in specifying a method of construction which will permit the article to be manufactured. It is the task of the designer to create within the minds of the people the desire of possession although he must utilize materials and is limited by manufacturing processes and the practical problems of production.

The designer is preoccupied with the individual; he is concerned with the individual's capabilities and limitations which must be reflected in sizes, weights, location of controls, color, materials, sound, and texture of a product. But above all, the professional stylist must have the ability to present a visual reflection of the accuracy of a mechanism, efficiency of operation, and the integrity of the manufacturer in order to supplement the work of the engineer.

In meeting the requirements of his profession, the designer works with all types of materials to find the right one for the job. Today, no medium has fulfilled as many requirements so essential to successful design as plastics and certainly no material finds a place in so many branches of industry.

The charm of plastics is as modern as tomorrow and is so strikingly individual that it cannot automatically lend itself to outmoded design. Its soft beauty imparts a quality to machine age products and no small part of plastics' popularity arises from the fact that the consumer demands beauty, a point which the designer is quick to capitalize.

During the past quarter of a century, the American home, its industries, and its general mode of living has experienced a gradual transformation. The development of plastics and the inception of the profession of industrial design, together have been an active and continuing force

(continued from page 24)

many types of packaging are short run. On the other hand, there are many types which are long run and of course I am sure that injection molding is going to consume a tremendous quantity of plastic molding material. Like everything else, that is injection molded, there are some very poor plastic boxes on the market. These boxes are poor because they are full of strains and are carelessly molded. The cycles at which the boxes are molded are too fast for the given machine with the result that the plastic is embrittled as it passes through the heating cylinder and even if mold temperature is carefully regulated, the box is going to be a poor one in service. Again, the heating cylinder temperatures are correct and the loading of the machine is correct, but the temperature of the mold is neglected and here again, the box will not be satisfactory in service. To produce a good, tough, clear, strain-free box, requires conservative rating of the injection machine and it requires operation of the cylinder at a heat low enough not to embrittle, darken, discolor or otherwise impair the properties of the plastic passing through it. At any rate, every injection molder should make sure that he gets, reads, and keeps the little magazine "Plastics Packager," because there are more new horizons opened in the packaging field at the present time than any other that I know of for injection molded plastics. I also wish to compliment the Editors of "Plastics Packager" because of the fact that they give the complete name and address of the manufacturer of the articles which they are describing. All too many times, plastic stories do not give the complete address of the manufacturer and this paper is immensely increased in prestige and usefulness in my opinion because it gives the complete story on each product which they write up. Monsanto is keeping a record of stock boxes and stock molds and all injection molders should file their information on proprietary boxes with Monsanto so that inquiries can be channeled back to them when received through the nationwide advertising that Monsanto is doing in the behalf of our industry.

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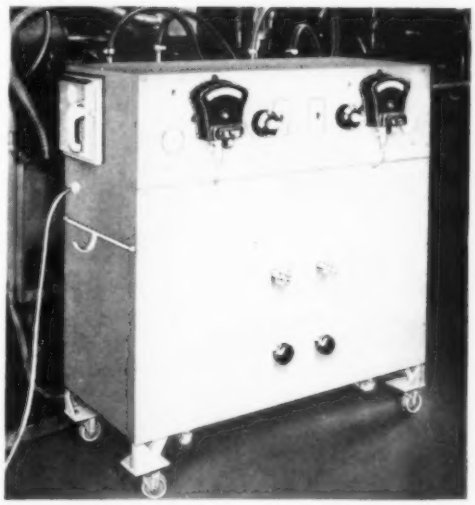
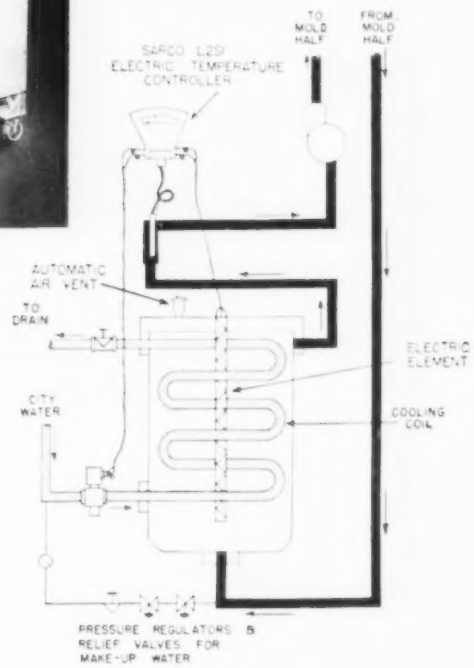
offers you many Exclusive Features



Sketch below shows one of the two water systems through which the Sarcotrol *Unit provides independent temperature control for each mold half.*



- Improves quality of molded parts
- Permits faster molding cycles
- Simplifies balancing of gates
- Permits optimum adjustments of cylinder temperatures, piston speed, injection pressures, etc.

THE *Sarcotrol* Mold Heating and Cooling Unit is designed specifically for the plastics industry—to meet all injection molding requirements to best advantage. It provides separately adjustable automatic control of each mold half, by means of two independent water circulating systems. Correct temperature is maintained within 1°F on either heating or cooling cycles.

Sarcotrol Units have also been successfully applied to control water temperatures of calender rolls for extruded sheets.

For the complete SARCOTROL ***story, ask for Technical Bulletin No. 7.***

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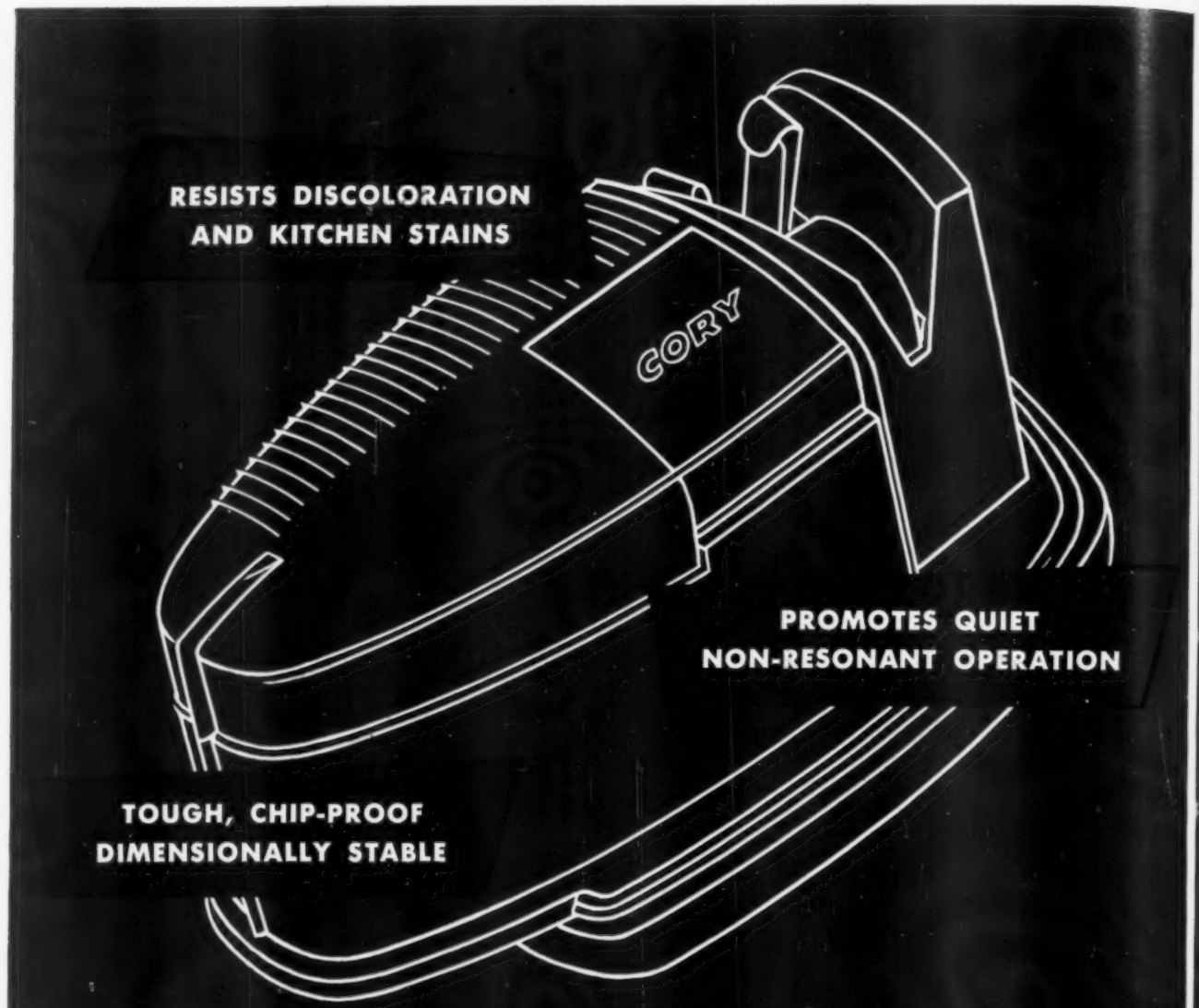

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